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Preferential Liberalization and Its Economy-Wide Effects in Honduras

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Abstract

This paper quantifies the likely benefits of trade and investment liberalization in a small, poor, open economy, using the accession of Honduras to the Dominican Republic-Central American Free Trade Agreement as a case study. The results show that bilateral trade liberalization with the United States is likely to have almost no effect on welfare in Honduras, while the reciprocal removal of protection vis-a-vis the rest of Central America would lead to significantly larger gains. Potential gains from increased net foreign direct investment inflows overwhelm those expected from trade reform alone, particularly if the new foreign direct investment generates productivity spillovers. However, if it is to replace Honduran investment rather than complement domestic capital formation, growth performance is unlikely to improve and may even suffer. The paper's results identify several areas for policy attention by Honduran policy makers to make the Dominican Republic-Central American Free Trade Agreement more development-friendly. These include carefully considering the budgetary implications of trade reform, widening social safety nets to counter the trends toward increasing income inequality, and sequencing the reforms to ensure a close alignment of Honduras' comparative advantage on the regional and global markets.

This paper—a product of the Development Prospects Group—is part of a larger effort in the group to monitor and assess the economic implications of trade policy developments. Policy Research Working Papers are also posted on the Web at http://econ.worldbank.org. The author may be contacted at dmedvedev@worldbank.org.

Preferential Liberalization and Its Economy-Wide Effects in Honduras

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1 Introduction

The Dominican Republic-Central American Free Trade Agreement (DR-CAFTA) was signed in August 2004 after a year and a half of intensive negotiations between the US, the Dominican Republic, and the members of the Central American Common Market (CACM): Costa Rica, El Salvador, Guatemala, Honduras, and Nicaragua. Many of the agreement's key provisions have been a subject of much debate and uncertainty. In particular, is the marginal opening of the US market likely to generate enough opportunities for DR-CAFTA exporters? Will the increase in import competition lead to a decline of key sectors in the developing members? What will be the public revenue implications of the agreement? Finally, what are the conditions under which the developing partners can reasonably expect to reap significant benefits from DR-CAFTA?

This paper addresses the above questions for Honduras—the most open country in Latin America (as measured by the trade-to-GDP ratio) but also one of the poorest—by building a computable general equilibrium (CGE) model of the Honduran economy and implementing a set of policy simulations aimed at illustrating the trade, production, consumption, and welfare implications of DR-CAFTA. While reasonable care has been taken to model the provisions of DR-CAFTA as realistically as possible—including gradual phase-in of tariff reductions, exclusion of key sectors (sugar in the US), differentiation between hub-and-spoke and multilateral implementation, etc.—the objective of this paper is not to develop a forecast of the future performance of the Honduran economy but to illustrate challenges likely to face Honduran policy makers in the course of implementation of DR-CAFTA. The paper is organized as follows. Section 2 offers a brief summary of the major provisions of DR-CAFTA, while section 3 reviews the previous estimates of the likely effects of this agreement. Section 4 discusses the data used in this exercise and the structural features of the economy of Honduras in the base year. Section 5 introduces the main features of the CGE model. Section 6 presents the results of trade reform simulations, while section 7 shows the outcomes of scenarios that allow for DR-CAFTA trade liberalization to be accompanied by increased net FDI inflows. Section 8 offers concluding remarks.

2 Summary of DR-CAFTA

The main objective of DR-CAFTA is to lock in and expand the unilateral preferences granted to Latin American members through the Caribbean Basin Initiative (CBI) and Generalized System of Preferences (GSP) programs, while simultaneously opening markets in Central America and the Dominican Republic to US exports.[1] In agriculture, virtually all products will eventually be eligible for duty-free treatment, with the exception of sugar in the US, white maize in El Salvador, Guatemala, Honduras, and Nicaragua, and potatoes and onions in Costa Rica (World Bank, 2006). More than half of all current US farm exports are accorded zero tariff treatment immediately, with the duties on the remainder phased out over a 15–20 year horizon (USTR, 2005b). For Latin American members, the agreement consolidates the existing preferences, introduces some flexibility in non-tariff barriers (e.g., doubling the sugar quota), and pledges technical assistance to help meet the US sanitary and phyto-sanitary standards for agriculture and food products. In manufacturing, DR-CAFTA promises to eliminate all tariffs on industrial and consumer goods between member countries, with 80 percent of current US exports becoming duty-free immediately (USTR, 2005b). Half of the remaining products will see tariffs phased out over the next five years, while the rest

[1] Currently, almost 80 percent of products from the Latin American members already enter the US duty-free due to existing preferences (USTR, 2005a).

are subject to 10 and 12-15 year schedules (World Bank, 2006). On the reciprocal side, close to 100 percent of exports by the Dominican Republic and CACM countries are afforded immediate zero-tariff treatment in the US (Francois et al., 2005).[2]

The liberalization of trade in services under DR-CAFTA represents a major expansion of the disciplines of CBI and GSP, which largely ignore this subject. For most Central American countries and the Dominican Republic, the main tenets of DR-CAFTA in services—opening of markets for competition, national treatment, and most-favored-nation treatment—were already written into the legislative and regulatory frameworks prior to DR-CAFTA. Therefore, the agreement mainly involves the lock-in of these reforms and continued efforts at their implementation and enforcement. However, the phase-in of many commitments is not immediate. For example, Latin American countries have pledged to allow US-owned insurance branches in four years and are working toward removing local residency requirements for the provision of professional services (World Bank, 2006). For other areas, such as the supply of banking services, trade between CACM countries and the Dominican Republic will not be liberalized for the first two years of the agreement.

DR-CAFTA also covers a range of "deep integration" issues. The investment provisions provide comprehensive protections that go beyond WTO commitments and cover all investment areas: enterprise, debt, concessions, contracts, investor-state dispute settlement, transparency (including anti-corruption), and intellectual property (Francois et al., 2005). Together, these measures effectively give US investors in the CACM countries and the Dominican Republic the same protections as under the US law. Other beyond-the-border issues include government procurement, customs cooperation, trade facilitation, trade capacity building, and labor and environment standards.

3 Previous Empirical Evaluations of DR-CAFTA

The uncertainty surrounding the potential costs and benefits of DR-CAFTA for the US and Central America has led to a fair amount of empirical research on the agreement even before its entry into force. An early study by Hilaire and Yang (2003) used the GTAP5 database and model to estimate large welfare gains of US$964 million for the United States and US$3,859 million for Central America, with the bulk of the gains coming from a large expansion of exports of textiles and clothing from Central America.[3] Another study by Brown et al. (2004), using GTAP5 data but applying it to a model with monopolistic competition under increasing returns to scale, estimated much larger effects with welfare rising by US$17.3 billion (0.2 percent of GNP) in the US and US$5.3 billion (4.4 percent of GNP) in Central America. Most of the welfare gains in these simulations come from the elimination of service barriers, but the results from merchandise trade alone are also significantly above those of Hilaire and Yang (2003).

A more comprehensive study of DR-CAFTA has been put together by the United States International Trade Commission (USITC), which relied on the GTAP6 database for finer regional disaggregation, significantly improved protection data, and a 2001 base year.[4] USITC (2004) made

[2]Only 19 products will continue to be subject to tariff duties, and these barriers will be phased out over a 10 year period (World Bank, 2006).

[3]The authors used equivalent variation as the welfare metric. The GTAP5 database has a base year of 1997; the five CACM members are grouped together with Belize, Panama, and 19 Caribbean nations to form a Central America and Caribbean aggregate.

[4]GTAP6 draws its protection data from the MAcMaps database developed by Centre d'Etudes Prospectives et d'Informations Internationales (CEPII). In contrast to GTAP5, the new data explicitly take into account preferential tariffs and tariff rate quotas (TRQs). Thus, estimates of gains from trade with GTAP6 tend to be significantly below those with the earlier database, since the initial level of protection is much lower. See World Bank (2004, chapter 1)

further adjustments to the data by accounting for preferential tariffs in the US, Central America, and the Dominican Republic that were not already captured in GTAP, moving the base year to 2005 (the expected date of DR-CAFTA's entry into force at the time of the study's writing), and modifying the regional structure of the database to focus specifically on DR-CAFTA member states. The results show that the US welfare and GDP gains are very modest, reaching US$166 million and US$228 million, respectively. USITC (2004) estimates that all US exports to DR-CAFTA partners are likely to increase, led by sales of textiles, apparel, and leather products (US$803 million, or 15 percent above the base year). DR-CAFTA countries increase their exports of textiles, apparel, and leather products by US$3 billion, while sales of sugar, meat, and dairy rise slightly and exports of other products decline. USITC (2004) does not consider the liberalization of services in its analysis, citing lack of reliable data on service barriers. While qualitative results for the US are similar to Hilaire and Yang (2003), the size of the welfare gains is several times smaller than what is reported in that study. This is consistent with the use of a much later base year and lower initial tariffs in USITC (2004), which adopted a baseline that was more representative of the actual conditions prior to the implementation of DR-CAFTA.

Francois et al. (2005) provide another assessment of DR-CAFTA using GTAP6, but without any modifications to the data. Their results show a welfare gain of US$116 million in the United States and US$1,028 million in Central America. The effects on US output are positive but very small, while the output of textiles and apparel in Central America rises by more than 40 percent with other sectors experiencing small to moderate declines. Francois et al. (2005) also implement several alternative simulations, including the likely effects of DR-CAFTA on FDI by endogenizing capital accumulation and saving rates. This results in a nine percent increase in the Central American capital stock and additional US$1,817 million welfare gain, while the US experiences an additional US$131 million increase in welfare.[5]

All of the above studies have examined DR-CAFTA in the context of a global model, limiting the scope of investigation to region-wide effects and ignoring potentially important country heterogeneity within Central America. Thus far, only one study (Bussolo and Niimi, 2006) considered the effects of DR-CAFTA in a single-country framework. The authors show that real GDP in Nicaragua could rise between 0.5 and 1.1, depending on assumptions about labor mobility. Imports of agriculture in Nicaragua are likely to rise by 21 percent, while exports of agricultural products and processed foods could increase by 5 and 6 percent, respectively. Most of the DR-CAFTA gains to Nicaraguan economy are achieved through own liberalization, with the benefits reduced by only one-quarter if the US does not reciprocate with its own tariff reductions. Furthermore, Bussolo and Niimi (2006) find that these adjustments represent more than three-quarters of the changes in real GDP, exports, and imports that would be expected if Nicaragua were to unilaterally liberalize vis-à-vis all of its trading partners.

The general conclusion from the above studies, with the exception of Brown et al. (2004), is that welfare gains from DR-CAFTA are likely to be small—around 1 percent of GDP or less for Central America and almost negligible for the US. Studies using more recent data, such as Francois et al. (2005), tend to show lower welfare gains, consistent with the fact that average tariffs have been declining since the mid-1990s. These results are in line with more general observations in Robinson

for additional details.

[5]The magnitude of the increase in capital stock appears fairly optimistic. Total investment (as a share of GDP) did not significantly increase in Mexico following the implementation of NAFTA, although FDI inflows did expand. Other than references to the relatively high current stock of US FDI in the region and the expected (but not quantified) improvements in the investment climate, Francois et al. (2005) do not provide reasons why such a large increase in total investment could materialize in Central America.

and Thierfelder (2002), who review the CGE literature on the effects of preferential liberalization and report that welfare gains in neoclassical models tend to be very modest. The results of Brown et al. (2004), even when only merchandise trade reform is considered, are considerably larger than the other estimates—again consistent with the observation of Robinson and Thierfelder (2002) that "new trade" features such as imperfect competition or liberalization of services tend to generate much larger improvements in welfare.

The main drawback of these studies is that even the most recent ones, with the exception of USITC (2004), rely on tariff data several years before the beginning of DR-CAFTA, and all but Bussolo and Niimi (2006) focus on Central America as a whole. This ignores important differences across countries, adds countries that are not DR-CAFTA members, and prevents differentiation between tariff reform within Central America and between Central American countries and the US. Furthermore, all of the above studies tend to focus on comparative static gains and do not address issues such as tariff reduction phase-in periods or capital accumulation over time. Finally, with the exception of Bussolo and Niimi (2006), who use a flexible direct tax rate to maintain a fixed fiscal deficit, it is not clear how the existing studies address the fiscal implications of lost tariff revenue. This paper addresses these drawbacks by focusing on Honduras, one of the smallest and poorest countries in Central America. The pattern of tariff cuts in this paper is designed to approximate the provisions of DR-CAFTA more closely than the studies that simply eliminate all import taxes on trade with the US, and the recursive dynamic nature of the model employed here allows for gradual phase-in of these tariff reductions. Furthermore, this paper provides a more realistic assessment of DR-CAFTA outcomes by explicitly juxtaposing tariff liberalization vis-à-vis the United States with a more comprehensive DR-CAFTA reform (including all DR-CAFTA members) and unilateral liberalization with respect to all trading partners. Finally, the analysis in this paper goes beyond traditional gains from trade by incorporating elements of "deep integration," which include increased inflows of FDI into Honduras and potential productivity spillovers from foreign-owned firms to the rest of the economy.

4 Honduras before DR-CAFTA

4.1 Social Accounting Matrix

The results of this paper are based on a 2004 social accounting matrix (SAM) for Honduras, which was created specifically for this exercise. The starting point for the detailed SAM is a macro-economic SAM, constructed from the national accounts, public expenditure, and balance of payment statistics.[6] The results of compiling these data are shown in Table 1. The row and column names denote, respectively, activities, commodities, factors, households, government, rest of the world, taxes, import tariffs, and saving-investment.

In order to disaggregate the macro-SAM in Table 1 into a detailed social accounting matrix, we draw on a number of data sources including a 1997 SAM for Honduras developed in Cuesta (2004), a 2004 Honduran household survey,[7] COMTRADE and TRAINS databases published by the UN, and a Central America regional SAM from GTAP.[8] The 1997 Honduras SAM includes 24 activities and 24 commodities, of which 7 are in agriculture, 2 in natural resources, 6 in manufacturing, and 9

[6]These are obtained from IMF *International Financial Statistics* (IFS), *Government Financial Statistics* (GFS), and *Balance of Payments Yearbook*.

[7]2004 Encuesta de Hogares de Propósitos Múltiples, or EPHPM, published by the Instituto Nacional de Estadística (`http://www.ine-hn.org/`).

[8]Documentation of the GTAP database is available on-line at `http://www.gtap.org` or in Dimaranan (2006).

Table 1: Macroeconomic SAM, 2004 (billions of lempiras)

	acts	coms	facts	hhld	govnt	row	tax	tar	invst	total
acts		260.5								260.5
coms	137.2			116.0	16.7	57.3			35.6	362.8
facts	120.5									120.5
hhld			120.5		1.4	27.6				149.5
govnt							17.3	4.1		21.4
row		89.9		2.2						92.1
tax	2.8	8.3		6.3						17.4
tar		4.1								4.1
invst				25.1	3.3	7.2				35.6
total	260.5	362.8	120.5	149.6	21.4	92.1	17.3	4.1	35.6	

Note: The SAM abbreviations stand for the following, from left to right and from top to bottom: activities, commodities, factors, households, government, rest of the world, taxes, import tariffs, and saving-investment. Row totals may differ from column totals due to rounding.
Source: Author's calculations based on IFS, GFS, and BoP data.

in services. We maintain the sectoral disaggregation of Cuesta (2004) for activities/commodities in agriculture, manufacturing, and natural resources (see Table 13 in the Appendix). Since a detailed disaggregation of service sectors is not particularly relevant for the analysis of trade reform scenarios, we aggregate the service sectors into four groups.

Total value added is split into labor and capital components using the shares from Cuesta (2004), who estimates that payments to capital (combined with land, and natural resources) are approximately 28 percent of total value added. Capital payments by sector are calculated in a similar fashion, using the data from Cuesta (2004). In order to decompose labor value added by skill level and sector of employment, we combine information from the 2004 EPHPM and Cuesta (2004). We define unskilled workers as those who completed less than a full cycle of secondary school, skilled workers as having a high school diploma, and tertiary-skilled workers as those with at least some education beyond secondary school. The distribution of labor income in EPHPM across these three skill (education) categories as well as across four broad sectors—agriculture, manufacturing, private services, and public services—is then used to decompose split labor value added. Although the survey allows workers to report nine different sectors of employment, most of the detail is in services, which receive a fairly aggregate treatment in our micro-SAM. Therefore, the only source of the required information is Cuesta (2004), and we split the value added in agriculture, manufacturing, and private services according to the shares calculated from his SAM. It was not possible to use the Cuesta (2004) shares directly (i.e., without calculating the survey shares first) because doing so would make the SAM distribution of value added completely inconsistent with the national accounts.

In order to disaggregate total imports and exports by trading partner and commodity, we use the data from the UN COMTRADE database. For each trading partner, import and export data were obtained at the 2-digit SITC (Standard International Trade Classification) level and then aggregated up to the level of detail of the micro-SAM. Rest-of-world values were obtained as the difference between exports and imports to all trading partners and those to the US, EU, and rest of DR-CAFTA. Tariff data were obtained from UN TRAINS as trade-weighted average tariffs at the same 2-digit SITC level. Data were also collected on import tariffs in Honduras' trading partners;

although these data are not part of the micro-SAM, they are essential for implementing the trade reform scenarios in the following sections. Tariff revenues were then aggregated at the commodity level of detail of the micro-SAM, and the economy-wide average tariff rate was not significantly different from the same rate calculated with balance of payments data. Due to data constraints, international capital flows are not distinguished by region of origin.

The public sector is a relatively small part of the economy of Honduras. Government current spending (including interest payments on outstanding debt) is 10 percent of domestic absorption, while the public investment-to-absorption ratio is 4.3 percent.[9] The public sector (excluding state-owned enterprises) employs just over 7 percent of the total workforce and 34 percent of the total stock of tertiary-skilled employees. We assume that in the final demand stage, the government consumes only its own commodity (public services). The government derives 29 percent of its revenues from direct taxes, 52 percent from activity and sales taxes, and 19 percent from taxes on international trade. The distribution of production (activity) and indirect (commodity) taxes is obtained from Cuesta (2004). However, the value of sales taxes collected in the coffee and banana sectors had to be adjusted to avoid having tax rates in excess of 100 percent. In these cases, sales tax rates were set to the economy-wide average for these sectors and the remainder allocated across all other commodities in accordance to the share of total taxes paid by each commodity.

Ideally, the final demand vector for households would be obtained from household survey data, but the EPHPM does not contain a consumption module and it was not possible to obtain a copy of the Encuesta Nacional de Ingresos y Gastos de los Hogares (ENIGH) which includes consumption data. Instead, we use the consumption vector of Cuesta (2004), which is based on the 1998–99 ENIGH. On the income side, the representative household is the sole recipient of all labor income, while capital income accrues to enterprises. 87 percent of these capital payments is remitted back to the households, while the rest is spent on government bonds (6 percent) and transferred to foreign owners of capital (7 percent). Households also receive transfers from abroad; these are mainly workers' remittances, which amount to 78 percent of total current foreign private transfers.[10]

The only available source of demand for investment goods by sector for Honduras is Cuesta (2004); however, the investment values reported in his SAM are not plausible since many sectors report negative investment even after accounting for drawing down of inventories. Instead, we use investment coefficients from a 2001 GTAP SAM for Central America to split aggregate investment according to the sectoral detail of the micro-SAM. Private investment is 84 percent financed by household saving, with the remainder coming from abroad. Foreign direct investment represents 83 percent of foreign capital inflows destined for the private sector and 51 percent of total capital inflows from the rest of the world.

The data on intermediate consumption (input-output coefficients) is obtained from Cuesta (2004), who uses input-output coefficients compiled by the Central Bank of Honduras. The Cuesta (2004) coefficients are used as an initial estimate for intermediate consumption; however, these are adjusted at a later stage in order to satisfy the SAM balancing requirements. Because of wide variations in the data sources, the initial SAM described in the above paragraphs is quite unbalanced, although the imbalances are limited to the commodity rows and columns. In order to balance the SAM, a cross-entropy estimation method was applied to minimize the distance from

[9] Absorption is defined as the sum of private and public consumption and investment. Interest payment flows (on both domestic and foreign debt) are not shown directly, but instead are netted out of the other transfers (e.g., government transfers to enterprises and households are net of non-tax payments to the government and domestic interest payments).

[10] The importance of remittances from Hondurans working abroad has risen steadily over time, increasing to 10 percent of GNI in 2004 from a 4 percent average in the 1990s.

initial to final input-output coefficients while ensuring that row and column totals sum up to the same value.[11] The final SAM is not shown here to conserve space, but is available from the author upon request.

The SAM captures only flow information about the economy and does not contain any data on stocks. Three types of stocks are particularly relevant for the CGE model in this paper: labor, capital, and debt. Information on labor volumes is obtained from the EPHPM survey; this is discussed in more detail in section 4.2 below. The ratio of total capital stock to GDP (a factor of 2.25) is obtained from Cuesta (2001), who cites various Honduras Central Bank (Banco Central de Honduras) bulletins as his source. Sectoral capital stocks are then derived by assuming that the rate of return to capital is the same in all activities. Public debt stocks are very high at 59 and 26 percent of GDP for foreign and domestic components, respectively, although the debt situation has improved somewhat since the 1980s, when total debt was well above 80 percent of GNI and debt service payments amounted to approximately one-third of total exports. Private external debt is negligible and is not considered in this analysis.[12]

4.2 Labor volumes and labor market segmentation

In order to obtain data on labor volumes and wages, we return to the EPHPM. Using this survey data, we calculate the number of workers (both wage workers and self-employed) in four aggregate sectors—agriculture, manufacturing, private services, and public services—in the three relevant skill levels. Since we used the survey data to decompose aggregate labor value added, the survey wage levels are close to the results we obtain when dividing the SAM value added by the above labor volumes. We assume that average wages at a more disaggregated level (i.e., within agriculture, manufacturing, and private services) are equal to average wages for the aggregate sector. For example, average wages in bananas, sugar, coffee, livestock, etc., are the same as the average wages for agriculture as a whole. It is likely that imposing this homogeneity assumption is overly strict, but this is the simplest and clearest way of calculating labor volumes without access to additional data. Furthermore, this simplification has potentially important modeling benefits. Most CGE models, including the one used in this paper (see section 5 for more detailed model description), do not contain the theoretical structure necessary to explain sectoral wage differentials, and usually treat them as fixed wage premiums. As a result, any degree of labor mobility across sectors generates instant productivity gains when a worker moves to an occupation with a higher wage. This may be reasonable when a worker switches from farming to manufacturing or services, but is probably implausible when switching from growing bananas to coffee. Therefore, if one wishes to consider longer-term scenarios in which labor is likely to be mobile, it is best to keep inter-sectoral wage differentials to a minimum.

The survey data show that the disparities between farm and non-farm wages at the same skill level are very large: an average farm worker can expect to earn about six times more if he or she switches employment to a non-agricultural sector. These large earnings differentials point to significant barriers to labor mobility and overall low labor market flexibility in Honduras. In order

[11] See Robinson et al. (1998) and Robinson and El-Said (2000). The approach is analogous to Bayesian estimation, and uses an optimization routine to minimize the discrepancies between the original unbalanced matrix A and the unknown balanced matrix A^* subject to prior knowledge of certain elements of the A^* matrix. For the Honduras SAM, the adjustment factors (ratio between final and original coefficients) range from 0.10 to 9.53. The average adjustment factor is 1.84.

[12] See, for example, International Monetary Fund (2006), which seems to use the terms "external debt" and "external public debt" interchangeably.

to determine whether these wage premia represent barriers to movement or are reflective of other worker characteristics (such as differences in average education levels, experience, etc., for workers in different sectors), we estimate a set of Mincer equations for wage workers and the self-employed (Table 2). For the former, the dependent variable is the log of monthly labor income, while for the latter, the dependent variable is the log of all earned income (i.e., excluding transfers) due to the difficulties of separating the labor and non-labor earnings components of the self-employed (as discussed earlier). The independent variables include a set of education dummies that range from incomplete primary school ($dedu2$) to some tertiary education ($dedu6$), as explained in the note to Table 2. Experience (exp) is approximated by the difference between the worker's age and his or her years of schooling, and the regression includes a quadratic term ($exp2$) to capture decreasing returns to experience. Finally, in addition to gender ($dfem$) and urban ($durb$) dummies, the vector of independent variables includes a set of sectoral dummies ($dsec2 - dsec9$) to capture potential earnings differentials (wage premiums) by sector of employment (also defined in the note to Table 2).

The estimates of Table 2 are in line with our expectations. Attaining progressively higher education levels results in significant and accelerating increases in earnings, although there do not appear to be any income benefits from completing less than a full cycle of primary school as compared with no formal education whatsoever. Males and urban dwellers tend to earn more than females and rural workers, controlling for other factors, and the returns to experience diminish at the margin. Incomes in manufacturing and services are significantly above earnings in agriculture and fisheries (the reference sector), although the differences appear less pronounced for the self-employed. In other words, even after controlling for education, experience, gender, and urban premiums, the analysis in Table 2 reveals significant earnings differentials across sectors.

4.3 Structure of protection

Previous discussion has pointed out that Honduras is already a very open economy and has a low level of external protection. The average tariff rate is only 6.11 percent and tariff dispersion is not very large, as shown in Table 3, which summarizes the distribution of tariffs and imports by commodity and trading partner. There are four main messages conveyed by this table. First, there is a clear bias in protection in favor of agricultural commodities across all trading partners. The second message is that tariffs on trade with other DR-CAFTA members tend to be higher than tariffs faced by the exporters from the US, the EU, and the rest of the world. Third, imports of agricultural products are relatively small; the share of agriculture in total merchandise imports is 13 percent. Table 3 also shows that the US is a very important source of imports for Honduras, accounting for 40 percent of total imports. Finally, there does not appear to be a sectoral bias in the composition of US imports, since the US shares of Honduran imports of agricultural and manufactured goods are roughly the same as for total imports.

The fact that 42 percent of Honduran agriculture imports come from the United States, combined with a relatively high level of protection of farm products (compared to other products), implies that the opening of these markets could result in negative income shocks for agricultural producers and may have adverse consequences for poverty in the absence of compensatory policies. At the same time, these effects could possibly be mitigated if the producers are able to take advantage of lower prices of intermediate goods through substitution toward imports. However, consumers of agricultural products would have the opportunity to take advantage of lower food prices, which is likely to be particularly beneficial to the urban poor.

Tariffs on US imports represent 33 percent of total tariff revenue and 7 percent of total income

Table 2: Labor Market Segmentation Estimation Results

	Wage workers		Self-employed	
Variable	**Coefficient**	**Std. Err.**	**Coefficient**	**Std. Err.**
dedu2	0.274	0.197	0.978	0.640
dedu3	0.563**	0.197	1.250†	0.640
dedu4	0.641**	0.200	1.429*	0.643
dedu5	0.807**	0.201	1.381*	0.646
dedu6	1.417**	0.198	1.999**	0.642
exp	0.052**	0.004	0.054**	0.006
exp2	-0.001**	0.000	-0.001**	0.000
dfem	-0.189**	0.022	-0.714**	0.049
durb	0.246**	0.026	0.488**	0.048
dsec2	0.941**	0.216	0.233	0.501
dsec3	0.690**	0.043	0.229†	0.126
dsec4	0.780**	0.103	1.676**	0.353
dsec5	0.427**	0.055	0.708**	0.125
dsec6	0.540**	0.045	0.691**	0.121
dsec7	0.778**	0.062	0.719**	0.145
dsec8	0.653**	0.052	0.905**	0.178
dsec9	0.490**	0.045	-0.095	0.144
	N	5782	N	2696
	R^2	0.417	R^2	0.349
	$F_{(17,5764)}$	196.477	$F_{(17,2678)}$	87.385

Significance levels : † 10% * 5% ** 1%

Note: Observations are weighted by sample weights, and robust standard errors are reported. Education dummies (*dedu*2 to *dedu*6) are defined as follows: less than complete primary, complete primary, less than complete secondary, complete secondary, more than secondary. No formal education is the reference dummy. Sector dummies (*dsec*2 to *dsec*9) are defined as follows: mining, manufacturing, water, electricity, gas, construction, commerce and hotels, transport and communications, financial services, public and social services. Agriculture and fisheries is the reference sector.

Source: Author's calculations using data from 2004 EPHPM.

of the government. Therefore, there are important revenue considerations related to tariff liberalization vis-à-vis the US, as the government will need to either significantly curtail its spending, find other sources of income to make up for the budgetary shortfall, or else borrow more and increase its debt. The choice of instruments to close the financing gap has important implications for the outcome of the reform (or model simulations). Higher indirect taxes tend to disproportionately affect the poorer households and are usually more difficult to collect, while raising direct taxes can lead to undesirable consequences such as income under-reporting or even reduced remittance inflows. Decreasing public spending could jeopardize important social programs, while taking on additional debt could threaten long-term solvency and macro stability. Whatever the mechanism, however, some of the gains in consumer surplus will be eroded if the implementation of tariff reform is revenue-neutral.

The average tariff rate faced by Honduran exporters on the global markets is 8.4 percent, but

Table 3: Honduran Import Tariffs and Import Values, 2004 (Percent and Millions of Lempiras)

	CACM and DR		EU		US		RoW	
Sector	τ	M	τ	M	τ	M	τ	M
Bananas	15.0	3.6	0.0	0.0	15.0	0.7	15.0	0.0
Coffee	15.0	1.1	14.3	0.0	15.0	4.0	15.0	9.6
Sugar	14.8	5.5	4.2	4.9	5.5	50.2	4.4	5.9
Mining	0.0	0.4	5	0.1	2.2	2.2	2.0	0.3
Livestock	8.4	240.1	5.0	0.0	0.2	35.0	1.1	22.6
Wood	6.8	91.1	9.9	313.9	9.6	48.1	10.0	52.1
Non-traditional crops	10.1	1673.3	8.2	113.0	10.5	950.6	11.2	741.1
Domestic crops	14.3	1226.2	4.6	167.4	6.2	2588.5	7.3	428.9
Oil	2.3	57.6	4.2	196.3	4.7	5691.9	4.8	4673.8
Food, beverages, tobacco	13.8	818.3	11.1	147.7	11.7	1073.2	11.2	668.9
Textiles	11.8	400.3	13.1	93.0	10.8	886.6	12.4	1156.1
Paper	10.7	1011.5	1.8	129.8	3.5	1507.6	5.9	463.5
Chemicals	4.7	1308.3	2.8	506.9	2.3	2316.4	3.7	1418.2
Metals, minerals, mach.	8.8	2510.3	1.8	2527.8	2.2	7626.7	3.7	6395.9
Other manufacturing	8.6	2667.4	4.9	1262.7	7.4	4307.1	7.7	7108.2
Merchandise trade	9.6	12014.8	3.8	5463.6	5.0	27088.6	6.1	23145.0
Agriculture	11.5	3240.8	8.1	599.2	7.3	3677.0	9.6	1260.2
Manufacturing	8.9	8774.0	3.3	4864.3	4.6	23411.6	5.9	21884.8

Note: For each trading partner, the first column (τ) contains the ad-valorem tariff rates collected by the Honduran authorities and the second column (M) contains total imports for each commodity. All tariffs are import-weighted. "RoW" stands for rest of the world,i.e., all trading partners other than CACM countries and the Dominican Republic, the EU, and the US. The manufacturing aggregate includes oil and mining.
Source: Author's calculations using data from UN COMTRADE and UN TRAINS.

the structure of this foreign protection is radically different across the country's export markets. Table 4 shows the distribution of tariffs and export values by commodity and destination. These data illustrate three main points. First, Honduras has virtually tariff-free access to the EU and the US, which account for 58 percent of its total merchandise exports.[13] Second, Honduran exports are heavily biased toward agricultural products, which comprise 59 percent of all goods exports. Third, its trade with other DR-CAFTA members is intensive in manufactured goods, but is also subject to relatively high protection.

Together, Table 3 and Table 4 show that the direct benefits of liberalizing trade with the United States as part of the DR-CAFTA accession are likely to be fairly limited. Pursuing additional liberalization with other DR-CAFTA partners is likely to have larger effect on welfare in Honduras, but only if the country is able to successfully negotiate improved access for its manufactured exports. At the same time, further integration with the rest of DR-CAFTA countries will likely involve lowering Honduras' own sizable tariff barriers against these partners, and making up for lost tariff revenue could put additional strain on the public budget.

[13]The only exceptions to this are the EU banana tariff and the US textile tariff, but exports of these goods are only 7.6 and 6.3 percent of total exports to each destination.

Table 4: Foreign Tariffs on Honduran Exports and Honduran Export Values, 2004 (Percent and Millions of Lempiras)

	CACM and DR		EU		US		RoW	
Sector	τ_x	X	τ_x	X	τ_x	X	τ_x	X
Bananas	0.0	36.8	6.3	398.8	0.0	2884.8	12.2	9.1
Coffee	0.0	72.5	0.0	3718.6	0	650.1	0.1	964.3
Sugar	0.0	26.2	0.0	0.0	0.0	313.9	9.3	97.5
Mining	0.0	61.3	0.0	183.3	0.0	994.7	4.0	386.9
Livestock	0.0	12	0.0	1.2	0.0	3.5	0.7	7.0
Wood	5.5	147.2	0.0	112.3	0.0	687.4	2.3	856.4
Non-traditional crops	0.0	1339.7	1.1	564.3	0.0	3251.4	4.0	82.7
Domestic crops	11.1	338.1	0.0	0.0	0.4	8.6	11.8	30.6
Oil	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Food, beverages, tobacco	4.7	1414.0	0.0	23.8	5.0	595.3	12.1	1039.2
Textiles	0.3	384.9	0.0	16.7	11.6	708.2	17.1	57.1
Paper	11.5	401.8	0.0	3.7	0.0	57.1	14.7	143.0
Chemicals	2.6	448.7	0.0	14.8	0.0	109.8	14.0	92.4
Metals, minerals, mach.	15.0	1158.1	0.0	159.6	0.0	500.6	6.1	320.7
Other manufacturing	0.9	1678.0	0.0	53.2	0.0	432.7	7.4	184
Merchandise trade	4.8	7519.4	0.6	5250.6	1.0	11198.3	6.0	4270.9
Agriculture	2.3	1972.5	0.7	4795.3	0.0	7799.7	2.6	2047.5
Manufacturing	5.7	5546.9	0.0	455.2	3.3	3398.6	9.1	2223.3

Note: For each trading partner, the first column (τ_x) contains the ad-valorem tariff rates collected by that trading partner on Honduran exports and the second column (X) contains total exports for each commodity. "RoW" stands for rest of the world, i.e., all trading partners other than CACM countries and the Dominican Republic, the EU, and the US. The manufacturing aggregate includes oil and mining.
Source: Author's calculations using data from UN COMTRADE and UN TRAINS.

4.4 Structure of production and demand

The economy of Honduras is dominated by service sectors, which account for 72 percent of GDP at factor cost and 49 percent of total production.[14] The first column of Table 5 provides additional detail on the structure of production by sector. Agriculture is dominated by domestic crops, followed by non-traditional crops (e.g., melons, sweet peppers, chiles, tilapia, shrimp) and livestock. Food, beverages, tobacco, and textiles account for slightly less than two-thirds of total value added and production in manufacturing.

The second and third columns of Table 5 show the export orientation and import dependence of each sector. With the possible exception of food, beverages, and tobacco, all other sectors appear to have a clear orientation toward either exports or imports, confirming that the sectoral disaggregation of the model is sufficiently detailed. There is a clear bias toward exports in most farm activities, with coffee and bananas selling virtually all of their output abroad, which makes these sectors vulnerable to global demand shocks and commodity price fluctuations. With the exception of metals, minerals, and machinery (a small sector), export shares in manufacturing are

[14] The difference between the two numbers is that the former does not include demand for intermediate inputs while the latter does, i.e., the distinction is between value added and value added plus intermediates.

all below 20 percent. Honduras exports only 7 percent of total output in the textiles sector, and 10 percent of the total production of food, beverages, and tobacco. Recall that the previous section identified these sectors as the only ones facing significant trade barriers in the US market, which implies that it would be difficult for Honduras to take full advantage of higher export prices in the US without significant changes in its export intensities.

Table 5: Sectoral Composition of Production, Exports, and Imports, 2004 (Percent)

Sector	Share in total production	Exports to total production	Imports to total demand	Share of total value added			
				Unsk. labor	Skil. labor	Ter. labor	Cap.+ land
Bananas	1.3	95.0	2.4	0.6	0.2	0.5	98.7
Coffee	2.1	98	11.6	25.3	0.1	0.8	73.8
Sugar	1.2	14.5	2.5	0.2	0.3	0.0	99.5
Mining	1.1	56.4	0.2	3.9	2.9	3.4	89.9
Livestock	4.2	0.2	2.7	25.8	0.0	1	73.2
Wood	0.9	76.9	48.3	0.2	0.0	3.1	96.6
Non-traditional crops	4.6	43.8	34.1	10.1	0.7	9.1	80.1
Domestic crops	6.9	2.1	19.9	68.2	7.8	5.2	18.7
Oil	0.0	0.0	100.0	0.0	0.0	0.0	0.0
Food, beverages, tobacco	11.6	10.2	9.1	71.2	9.8	0.1	18.9
Textiles	6.4	7.0	14.1	0.6	76.0	12.7	10.6
Paper	2.1	11.2	39.2	76.8	0.9	0.1	22.1
Chemicals	2.5	10.4	49.2	0.8	0.4	68.4	30.4
Metals, minerals, mach.	1.4	59.6	92.9	0.7	1.9	47	50.3
Other manufacturing	4.6	19.5	61.3	0.5	64.2	21.6	13.7
Electricity, water, gas	1.3	1.5	11.5	0.3	0.1	0.8	98.8
Construction	6.3	0.0	3.0	43.8	20.0	10.7	25.5
Other services	35.1	31.8	25.4	30.0	25.0	18.7	26.4
Public sector	12.8	0.0	0.0	34.6	23.1	42.4	0.0
Total	100.0	44.0	30.7	34.8	22.3	17.9	25.1
Agriculture	21.2	60.1	18.5	42.3	4.5	6.1	47.2
Manufacturing	29.6	30.1	47.3	42.2	26.3	12.0	19.5
Services	42.7	52.3	21.3	31.9	23.6	20.9	23.6

Note: The manufacturing aggregate includes oil and mining. Total production includes production for domestic consumption and exports. Total demand includes demand for domestically produced goods and imports.
Source: Author's calculations using data from the SAM.

Import dependence is under one-third of total demand for the economy overall, and is significantly lower in the farm sector. The earlier section highlighted the potential vulnerability of farmers to trade liberalization under DR-CAFTA since Honduras sources a large share of its agricultural imports from the US. However, Table 5 shows that, with the exception of wood and non-traditional crops, most farm activities are under moderate competitive pressure from imports.[15] One reason for the low penetration of foreign-produced farm goods is the relatively higher protection afforded

[15]The import dependence of the wood sector is close to one-half of total demand, but its share in total output is very small relative to other agricultural activities. Although the import dependence of domestic crops is not large relative to the economy-wide average, import dependence of one-fifth is not small in absolute terms. For example, it

to agriculture in Honduras; however, since tariffs are not prohibitive, it is unlikely to be the only reason. Thus, the relatively low import dependence is likely to limit the extent of negative income shocks for farmers—although some groups of agriculture producers, such as domestic crop farmers, could be affected more than others (e.g., large scale coffee and banana producers).

Import dependence is much higher in manufacturing sectors, particularly for metals, minerals, machinery, and other manufacturing. Since 37 percent of Honduran manufacturing imports (excluding oil and mining) come from the United States, trade liberalization under DR-CAFTA is likely to have significant effects on prices of manufactured goods and could hurt domestic producers. At the same time, these activities source a large share of their intermediate inputs from each other or from imports (the share of intermediate inputs in total production of manufactures, excluding oil and mining, is 70 percent), and therefore lower input prices will work to offset the adverse effects of lower output prices for producers.

The last four columns of Table 5 show the composition of value added for each sector. Overall, there does not appear to be an obvious relationship between export orientation and import dependence on the one hand, and unskilled and skilled labor intensities on the other. Therefore, it is difficult to anticipate beforehand the likely effects of trade liberalization on factor returns. Note that the contribution of capital and land to total value added is very high in a number of farm activities, and somewhat low in several manufacturing sectors. One of the reasons for this is that SAM estimates of capital and labor shares in total value added sometimes contain sectoral biases (see, for example, Harrison et al., 2003). For instance, agricultural activities may exhibit a high share of capital in total value added because self-employed income may be classified as returns to capital. On the other hand, some manufacturing activities may show low capital shares due to low profitability.

5 Model Description

The CGE model used in this paper is the World Bank's prototype single-country model.[16] Production takes place under perfect competition and constant returns to scale, and is modeled in a nested constant elasticity of substitution (CES) fashion to reflect various substitution possibilities across inputs (see Figure 1). In the top nest, sectoral output (XP) is produced as a CES combination of intermediate products (ND) and value added (VA). The elasticity of substitution may be set to zero, yielding the usual fixed-coefficients top-level output structure. The second, third, and fourth nests decompose intermediate inputs and value added into their respective components. Total intermediate demand is split into intermediate demand by commodity (XAp), which is then decomposed into domestic (XD) and imported (XM) inputs. Total value added is composed of a capital-labor bundle (KL), which in turn consists of a combination of unskilled labor (UL) and capital and skilled labor (KSK). The unskilled labor bundle is composed of workers who completed no more than a secondary level of education, while the capital-skilled labor bundle contains aggregate capital (KT) and tertiary-skilled workers (SKL). This nesting structure allows highly skilled workers to be complements to capital. At the bottom level of the value added production nests, factor demands (L^d and K^d) are functions of wages and rental rates, which can be both type- (i.e., skilled and unskilled labor) and sector-specific.

is roughly similar to the import dependence of US steel industry, where imports seem to have quite an impact. In addition, this sector is large and sources a large share of its imports from the US.

[16] See van der Mensbrugghe (2005c) for detailed model documentation and van der Mensbrugghe (2005a) for the user's guide.

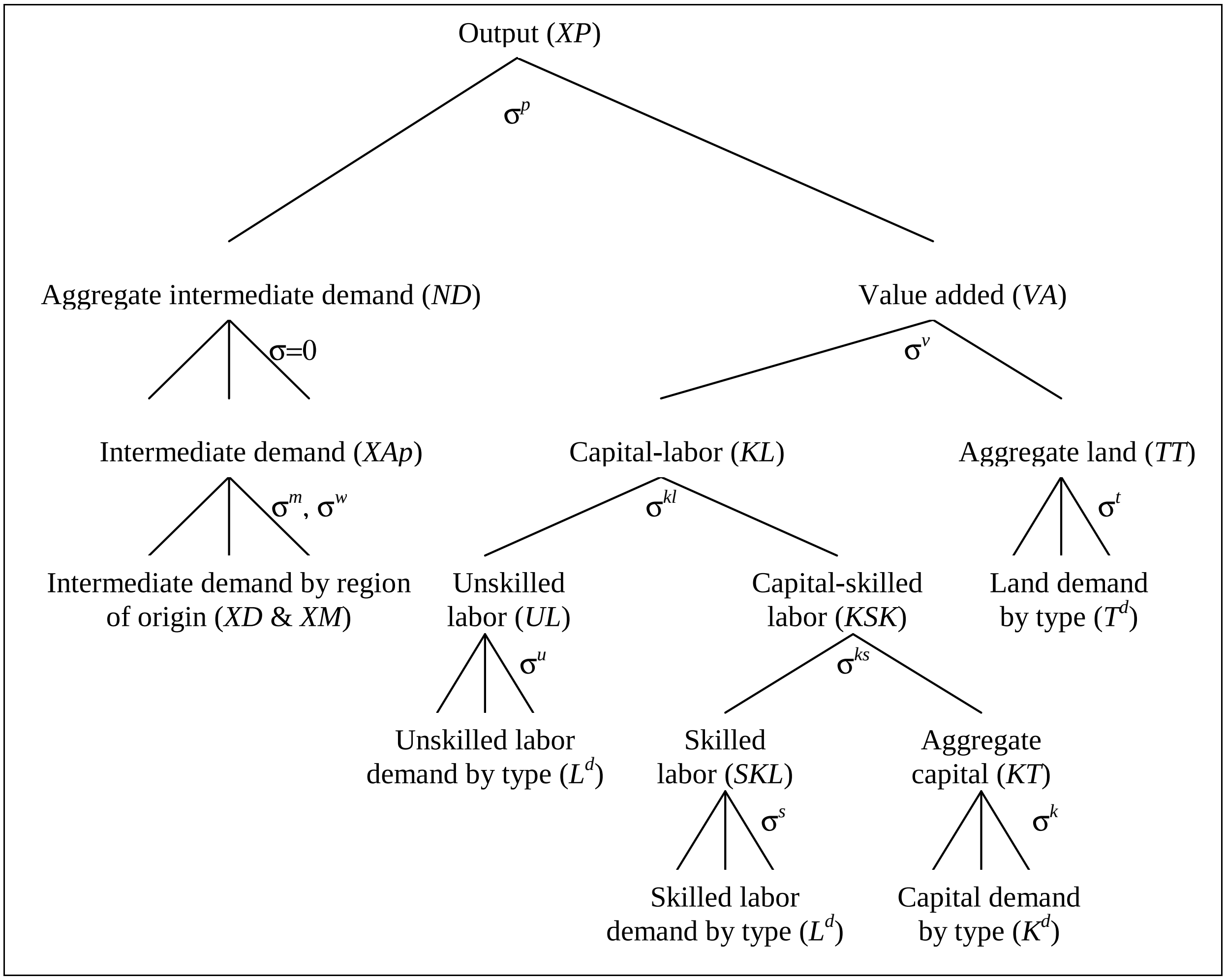

Figure 1: Nested Structure of Production
Source: van der Mensbrugghe (2005c).

Produced goods are transformed into consumed goods by means of a transition matrix, which has a simple one-to-one mapping due to data limitations. The household demand structure is determined according to the linear expenditure system (LES), in which consumers maximize Stone-Geary utility functions subject to the disposable income constraint.[17] Other final demand agents—government and investment—use the CES expenditure system. Import demand is modeled using the nested Armington specification, in which consumer products are differentiated by region of origin and combined using CES functions.[18] On the supply side, producers allocate output to domestic and export markets the model according to a constant elasticity of transformation (CET) specification. World prices are exogenous, which means that any increase in import demand or export supply can be satisfied without affecting global prices (small country assumption).[19]

The aggregate stock of capital is allocated across sectors in a CET fashion, with capital being

[17]See Deaton and Muellbauer (1980, Chapter 3) for a detailed discussion of the LES demand system, and Stone (1954) for the Stone-Geary utility function.
[18]See Armington (1969).
[19]The export elasticity in the sugar sector is finite to reflect the US sugar quota.

freely mobile across all sectors. Tertiary-skilled labor is also fully mobile. In contrast, markets for low- and medium-skilled labor are segmented into farm- and non-farm categories. Within each segment, labor is perfectly mobile across activities (e.g., from bananas to coffee in agriculture), but mobility across segments is limited by a finite inter-segment migration elasticity.[20] The initial level of migration is set at 1 percent of the farm sector labor force, a level broadly consistent with the historical rates of rural-to-urban migration in Honduras reported in WDI for the period 1974–2004. Although international migration is likely to be an important element in the dynamics of the Honduran labor market, it is not considered in this analysis due to the difficulties of modeling this flow in a single-country setting.

The version of the model used in this paper assumes no change in the degree of resource utilization, or fixed employment. On the one hand, this assumption is reasonable given that the official unemployment rate in Honduras has been fluctuating around four percent over the last five years. On the other hand, unofficial estimates place the unemployment rate as high as 28 percent, in which case the assumption of the unchanging unemployment rate could be more controversial. However, real wages in Honduras have been stable over the same period (Gindling and Terrell, 2006), which provides indirect evidence of significant labor market rigidities. In this case, unless we expect significant institutional improvements that make the Honduran labor market more competitive (not very likely given the historical performance of the economy, particularly in the business-as-usual scenario), the fixed unemployment rate assumption seems appropriate.

The volumes of government current and investment spending are fixed as shares of real GDP, while the deficit (in real terms) is also fixed. Public revenues adjust to clear the government balance by means of a flexible household direct tax rate. The shortfall between government investment demand and public saving is satisfied by a combination of domestic and foreign borrowing: domestic borrowing is a fixed share of the difference between public investment and public saving, while foreign borrowing makes up the residual. The total amount of foreign borrowing is limited by the restriction that foreign debt must remain a constant share of GDP throughout the model horizon, a restriction which implies that increases in foreign borrowing by the public sector crowd out private borrowing and private investment. Changes in the private capital stock are determined by the available quantity of private investment. Foreign direct investment, representing the majority of private capital flows from abroad, is exogenous and fixed as a share of real GDP. The investment-to-GDP ratio is fixed at the base year value and a flexible marginal propensity to save out of household disposable income ensures that total saving equals total investment. The current account balance is fixed by the available quantity of foreign saving, and a flexible real exchange rate clears the balance of payments constraint.[21] The price of absorption is set as the numéraire.

The model is solved in a recursive dynamic mode, in which a sequence of end-of-period equilibria are linked with a set of equations that update the main macro variables. There are three determinants of real GDP growth in the model: labor supply growth, capital accumulation, and increases in productivity. The volumes of all three types of labor grow exogenously at the rate of growth of the working age population (ages 15-64), obtained from World Bank population forecasts.[22] The capital stock in each period is the sum of depreciated capital from the period before

[20]Note that the migration function is only specified in one direction and the level of migration is bounded from below by zero. In other words, no worker would migrate from non-farm to farm activities even if the agricultural wage surpassed the non-agricultural one.

[21]The balance of payments equation is redundant due to Walras's Law and is dropped from the model specification.

[22]Note that this assumption ignores the recent efforts by the government of Honduras to scale up resources toward achieving the Millennium Development Goals, particularly the education target of reaching universal completion of primary school by 2015. Since almost 45 percent of the total population of Honduras is 16 years old or younger,

and new investment, which is a fixed ratio of real GDP in the previous period.

The behavior of the third component—productivity—is factor- and sector-specific. Labor and capital productivity in agriculture grow exogenously at one percent per year, broadly consistent with the econometric literature on productivity growth in low income countries.[23] For all other sectors, capital productivity remains fixed throughout the model horizon, while growth in labor productivity (which is assumed to be Harrod-neutral, purely labor-augmenting technical change) can be exogenous or endogenous depending on the type of simulation. The evolution of skill- and sector-specific labor productivity $\lambda^L_{l,i}$ is given by the following equation:

$$\lambda^L_{l,i,t} = \left(1 + \gamma^L_t + \chi^L_{l,i}\right) \lambda^L_{l,i,t-1} \tag{1}$$

In the baseline scenario, also referred to as Business-as-Usual (BaU) scenario, γ^L_t is endogenous while real GDP growth is fixed. This allows the user to calibrate the model to any given GDP growth rate. In scenarios other than BaU, γ^L_t is fixed in each period at the BaU solution level, and GDP growth becomes endogenous. Thus, in the absence of any shocks, the BaU GDP growth rate is reproduced exactly. In policy simulations, real GDP growth may differ from BaU due to faster/slower accumulation of labor or capital, or shocks to the sector-specific productivity shift parameters for labor, capital, or land $(\chi^L_{l,i}, \chi^K_{k,i}, \chi^T_{t,i})$. In other words, variations in GDP growth across scenarios can be directly attributed to the simulated policy reforms, allowing for clear welfare comparisons.

The elasticity values used in this paper come from the World Bank's global LINKAGE model (van der Mensbrugghe, 2005b). The substitution (Armington) and transformation (CET) elasticities are "middle of the road" values in the range of elasticities used in the recent CGE literature. Many econometrically estimated Armington elasticities tend to be quite low, often below one, while the estimated CET elasticities are usually several times greater than the corresponding Armingtons (Annabi et al., 2006). Many of the CGE studies published by the International Food Policy Research Institute (see, for example, Lofgren, 2001) also use fairly low Armington elasticities, ranging between 0.2 and 2.4, while their CET elasticities tend to be around 1.5. On the other hand, studies such as Harrison et al. (2001) often use Armington (CES) elasticities of 15 at the top level and as high as 30 at the bottom. Armington elasticities in the GTAP model, which are both econometrically estimated and drawn from literature surveys, are on average 3.5 for the top nest and 7.0 for the bottom (Dimaranan, 2006). However, users of the GTAP model have often used higher elasticities; for example, Hertel et al. (1996) double the default Armington (CES) elasticities in their evaluation of the consequences of the Uruguay Round. The LINKAGE elasticities, which are on average 19 percent higher than the default GTAP elasticities, thus appear to be a reasonable compromise between the extremely high and low values.

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significant progress toward this goal is bound to have large distributional and temporal effects on the labor force: as enrollment, completion, and continuation to the next education cycle rates rise, the relative share of unskilled labor would decline in favor of more skilled categories. Furthermore, increasingly larger parts of the labor force would leave the labor market (to go to school) and return after having completed their education. We ignore these possibilities for the sake of simplicity and to keep the discussion focused on trade liberalization and its immediate consequences. See Bussolo and Medvedev (2006) for a more detailed exposition.

[23] For example, Martin and Mitra (1999) estimate that total factor productivity in agriculture grows at an annual rate of 1.44 to 1.99 percent in low income countries.

6 Trade Reform

6.1 Description of simulations

In order to assess the potential effects of DR-CAFTA accession for Honduras, this section contrasts a Business-as-Usual scenario with five alternative simulations that highlight different aspects of trade liberalization under DR-CAFTA, while the next section will focus on the potential effects of increased FDI inflows into Honduras. The following paragraphs review the main features of each of the scenarios, starting with the *BaU*. To keep the discussion focused, the text will concentrate on major differences across scenarios; features that are not specifically mentioned remain the same in all scenarios as in the *BaU*.

*Business-as-Usual (*BaU*).* The *BaU* simulation defines a backdrop against which other scenarios will be compared by establishing a baseline growth path from 2004 through 2016. Under *BaU* conditions, real GDP per capita grows at an average rate of 2.2 percent per year. This is consistent with the IMF, World Bank, and government of Honduras growth projections (see, for example, International Monetary Fund, 2006), but much faster than the 0.5 percent average annual growth recorded over the 1990–2004 period.[24] Most macroeconomic variables, including foreign remittances, public spending, private investment, FDI, public investment, and external debt, remain a fixed share of real GDP through the model horizon (i.e., they grow at the same rate as real GDP).

Bilateral CAFTA with the US (C_{BL}). The C_{BL} simulation envisages a gradual removal of tariff barriers between the USA and Honduras over the 2004–2016 period. Although in principle DR-CAFTA is a regional agreement rather than a hub-and-spoke arrangement, this simulation models the agreement's implementation as a bilateral deal for two reasons. First, this choice facilitates comparison with other studies of DR-CAFTA, all of which have modeled it as a bilateral arrangement. Second, since DR-CAFTA preferences gradually replace those available under the CBI as Central American countries join the treaty, the agreement is identical to a hub-and-spoke arrangement until all member countries ratify it. Therefore, this scenario models DR-CAFTA as a bilateral agreement, while the implications of the accession of all other parties to the agreement will be explored in a subsequent simulation.

Given the limited level of sectoral detail in the model, it is impossible to reproduce the implementation of DR-CAFTA tariff provisions exactly. Instead, this simulation imposes a pattern of liberalization that is roughly similar to the main provisions of the agreement. In order to change the tariff structure of Honduras' trading partners, this paper uses the protection data of Table 4 to shock the partner-specific vector of world export prices—in this case, that of the US. Since most of the US trade barriers are to be eliminated immediately, this simulation increases the US export prices by the full amount starting in 2007. This is clearly an optimistic scenario, especially because several US import quotas (which are not explicitly modeled in this analysis) will be relaxed but not fully eliminated.[25] Nonetheless, it is useful to consider it as a "best-case" possibility. Honduras'

[24] Between 1990 and 2004, real GDP growth averaged 3.3 percent—just slightly faster than the growth rate of population—and consumption per capita has been virtually stagnant.

[25] To take account of the sugar quota, the model imposes a finite export elasticity on the exports of sugar to the US. In the case of a finite elasticity, the producers' decision to export more drives down the world price and leads to lower export demand. The result is that the value of Honduran sugar exports to the US in *BaU* increases by only three percent between 2004 and 2016. Currently, Honduran sugar quota is 9.6 tons, which expands immediately to 17.6 tons following the implementation of DR-CAFTA and eventually (in year 15 of the agreement) to 10.2 tons. However, the US reserves the right to keep the sugar quota at its original pre-CAFTA level and instead compensate Honduras unilaterally. The complicated and restrictive language of sugar quota provisions has led Francois et al. (2005) to conclude that "the trade agreement will produce no substantial changes in current bilateral trade conditions

own tariffs versus the United States are lowered according to the following schedule: tariffs on agricultural imports are gradually reduced by two-thirds between 2007 and 2016, while manufacturing tariffs are cut by 80 percent in 2007 and gradually brought to zero over the remaining period.

To further decompose the effects of CAFTA into the consequences of removal of own protection and rising export prices, we implement two additional simulations. The first one, C_{HN}, reduces Honduran import tariffs according to the schedule in the previous paragraph without any modifications to the export prices. The second one, C_{US}, changes the US export prices while leaving protection in Honduras unchanged. Neither of these scenarios are meant to represent policy simulations—they are included only as a decomposition exercise to illustrate the relative contributions of removal of protection by Honduras and the United States to the total effect of the CAFTA simulation.

Bilateral CAFTA with the US with high Armington income elasticities (C_{BL}^{hi}). The setup of this simulation is virtually identical to the C_{BL} scenario above, with one important difference in modeling import demand. In the standard version of the model, domestic goods and imports are aggregated into an Armington composite with a CES function. This implies that a 1 percent change in demand for the Armington composite will change demand for both domestic and imported goods by 1 percent: i.e., the "income" elasticity is equal to unity. This assumption simplifies the calibration procedure (because no additional parameter estimates are required beyond the Armington elasticity), but may not be very realistic. In order to allow the income elasticity of imports to rise following trade liberalization, we modify the Armington aggregation function by adding Stone-Geary-type shift parameters ("minimum consumption requirements"). The resulting domestic and import demand functions (derived in Appendix A) resemble demand equations in an LES system, and collapse to the original CES specification if both shift parameters are set to zero. To simplify calibration, the model sets the domestic shift parameter to zero (therefore assuming that the domestic income elasticity is unity) and uses the import income elasticity and the import demand equation to calibrate the import shift parameter.[26] In the current version, both shift parameters remain fixed throughout the model horizon, although it is possible to allow the income elasticity to grow over time by recalibrating the import shift parameter after each solution period.

Multilateral CAFTA (C_{ML}). This simulation is identical in virtually every aspect to the C_{BL} scenario described above, with the exception that tariff reductions are phased in with respect to all members of DR-CAFTA (i.e., including the CACM countries and the Dominican Republic) rather than with respect to the US alone.

Full multilateral liberalization (FL). This is a reference simulation in which trade between Honduras and all of its trading partners is fully liberalized. On the imports side, Honduran tariffs on all products are eliminated in ten equal steps between 2007 and 2016. At the same time, Honduran export prices gradually rise by the full amount of tariffs levied on these exports in 2004. It is important to note that this simulation is not meant to reflect any specific trade policy outcome (e.g., the conclusion and implementation of the Doha Development Round) but is instead a benchmark scenario that allows us to appreciate how close DR-CAFTA gets Honduras to a pure free trade scenario. Or, put another way, this simulation allows us to assess whether the pattern of sectoral adjustment (and therefore revealed comparative advantage) under DR-CAFTA is consistent with Honduras' comparative advantage on the global market.

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in this sector." Therefore, due to uncertainties regarding the implementation of the quota expansion, we keep the world price of sugar constant in all simulations, effectively leaving the quota unchanged.

[26]The import income elasticity is set to 1.2. See Appendix A for calibration details.

6.2 Macroeconomic results

We begin the discussion of simulation results by focusing on macroeconomic variables. Table 6 shows the evolution of GDP and its components, exchange rate, welfare, and some key ratios for each of the simulations described in the previous paragraph. Real GDP at market prices grows at an average annual rate of 4.17 percent, and investment and public consumption follow the same path. Changes in relative prices explain why the "nominal" GDP grows at a slightly faster rate. Export growth lags behind the growth of imports while the real exchange rate appreciates slightly (by 0.64 percent over the entire period).[27] There are several reasons why private consumption is growing slower than real GDP. Since the income elasticity of demand is higher for services than for agriculture and manufactured goods, consumer preferences (both in terms of domestically produced goods and imports) shift to services over time. However, as the share of services in total imports rises, the government collects less tariff revenues since there are no tariffs on services. In addition, since production taxes are levied only on manufactured goods and sales tax rates are generally higher for industrial and agricultural products than services, the share of these items in the fiscal budget declines over time. Since the real level of government expenditure grows at the same rate as real GDP, household taxes must rise to maintain a fixed fiscal deficit.[28] Although the increase in the tax rate is not very large (it rises from 4.28 to 4.83 percent), it is enough to slow the growth in disposable income by 0.15 percentage points per year.

The C_{BL} column shows the growth rates in GDP and its components attained under the CAFTA simulation described in the previous section. By 2016, the economy-wide average tariff declines to 3.51 percent (from 6.07 percent in BaU), and the exports price index increases from 99.25 to 100.08. As a result, both import and export growth accelerate significantly relative to the BaU scenario, and the trade-to-GDP ratio in the final year rises by more than 5 percentage points. The increase in import flows is due entirely to the re-orientation of trade toward the US. The volume of imports from the US rises by 30.4 percent relative to BaU while the volume of imports from all other destinations falls by 33.9 percent. In nominal terms, the 2016 US-sourced imports rise by 12,514 million lempiras while imports from other trading partners fall by 7,696 million lempiras, indicating that trade creation outweighs trade diversion. On the other hand, due to the increasing orientation of the Honduran economy toward the external sector, export volumes rise across the board: exports destined to the United States increase by 18.5 percent relative to the BaU simulation, while exports to all other destinations rise by 29.1 percent, albeit from a much smaller base.[29]

Other macro variables remain virtually unchanged relative to BaU conditions. Private consumption grows slightly faster than in the baseline, and welfare increases by 185 million lempiras, or 0.08 percent of GDP in the final year. Therefore, the economy-wide gains from tariff liberalization vis-à-vis the US are extremely modest: the improvement in welfare is only 4.2 percent of the expected gains from full multilateral trade liberalization (see the last column of Table 6). There are several reasons for this result, and they are explored in the following paragraphs.

The fifth and sixth columns of Table 6, C_{HN} and C_{US}, shed more light on the outcome of the previous simulation by decomposing trade reform into an own liberalization and US liberalization

[27] One factor limiting the growth of exports is the US sugar quota, which prevents Honduran producers from significantly expanding exports of this commodity.

[28] Another factor that compounds this increase in taxes is the fact that the price of publicly produced goods (the only commodity consumed by the government) rises relative to other final demand prices because the government uses more expensive labor categories more intensively.

[29] In 2016, the volume of exports to the US is 3,826 million lempiras above the BaU level, while the volume of exports to all other markets is 2,153 million lempiras above BaU.

Table 6: Initial Levels and Changes in Macroeconomic Aggregates, Trade Scenarios

	2004	BaU	C_{BL}	C_{HN}	C_{US}	C_{BL}^{hi}	C_{ML}	FL
GDP at market prices	135.7	4.22	4.23	4.21	4.24	4.23	4.32	4.43
Real GDP at factor cost	120.5	4.23	4.23	4.23	4.23	4.23	4.23	4.24
Real GDP at market prices	135.7	4.17	4.16	4.16	4.17	4.18	4.18	4.21
Private consumption	116.0	4.15	4.16	4.14	4.17	4.17	4.21	4.31
Public consumption	16.7	4.17	4.16	4.16	4.17	4.18	4.18	4.21
Investment	35.6	4.17	4.16	4.16	4.17	4.18	4.18	4.21
Private investment	28.3	4.17	4.16	4.16	4.17	4.18	4.18	4.21
Public investment	7.3	4.17	4.16	4.16	4.17	4.18	4.18	4.21
Exports	57.3	3.99	4.45	4.48	3.98	5.03	5.21	6.12
Imports	89.9	4.03	4.34	4.34	4.05	4.72	4.89	5.58
Real GDP per capita	19,254	2.16	2.15	2.15	2.16	2.17	2.17	2.20
Real exchange rate	1.00	-0.05	0.00	0.00	-0.06	0.03	-0.01	-0.02
Welfare (EV)			185	-336	532	458	1,612	4,400
Trade-to-GDP	108.5	105.3	110.6	110.8	105.2	117.0	117.9	127.5
Investment/absorption	21.2	21.2	21.2	21.2	21.2	21.2	21.1	21.0
Prv. inv./absorption	16.8	16.8	16.8	16.8	16.8	16.8	16.8	16.7
Gov. inv./absorption	4.3	4.3	4.3	4.4	4.3	4.3	4.3	4.3
Gov. cons./absorption	9.9	9.9	9.9	10.0	9.9	9.9	9.9	9.9
Gov. total spending/abs.	14.3	14.3	14.3	14.3	14.3	14.3	14.2	14.2

Note: For each variable, the "2004" column contains the base year values. GDP and its components are in billions of lempiras, real GDP per capita is in lempiras, and all ratios are in percentage terms. Columns 3 through 9 show the average annual growth rates between 2004 and 2016 for GDP and components, GDP per capita, and the exchange rate. The growth rates are calculated assuming exponential growth between the first and the last period. Change in welfare is shown as the absolute difference (in millions of 2004 lempiras) between the value of the expenditure function in 2016 in BaU and in each of the other simulations. Ratios such as trade-to-GDP are shown as values in 2016 for each simulation.
Source: Author's calculations.

components. The main point of the C_{HN} column is that own tariff liberalization vis-à-vis the US is actually welfare-reducing for Honduras. This happens despite the fact that consumer prices are significantly lower than in BaU and annual growth in total household income (through effects on factor prices, explored in more detail in the following section) is 0.11 percent above the growth observed in BaU. The main reason for this outcome is the requirement of a fixed fiscal deficit: in order to compensate for the loss in tariff revenue, the direct tax rate in 2016 increases by 1.05 percentage point relative to BaU (from 4.83 to 5.88 percent) and disposable income in the C_{HN} scenario actually grows slower than in BaU. As a result, consumption and welfare in 2016 are lower in the C_{HN} scenario relative to BaU. This outcome seems counterintuitive in a (mostly) neoclassical trade model, especially considering that it is not an artifact of model dynamics but is also present in comparative static results. However, several qualifications are in order. First, it is important to recognize that this scenario operates in a second-best world. In other words, while the removal of all tariff protection in Honduras (with a revenue-neutral increase in direct taxes) is unequivocally welfare-enhancing, the same does not need to hold if protection is only removed versus certain trading partners, such as the US. Second, the area of Harberger's triangles—the source of efficiency gains from trade in the Heckscher-Ohlin world—depends on the ability of Armington agents to substitute cheaper imports for domestic goods in their consumption basket, i.e., Armington elasticities. Finally, the size of Harberger's triangles also depends on the ability of agents to reallocate production towards more efficient sectors following trade reform, i.e., factor mobility. In our model, capital is freely mobile across sectors, but labor mobility across farm and non-farm segments is limited by a migration function. While we believe that this migration function is a more accurate representation of labor market rigidities in Honduras, as compared to an assumption of freely mobile labor, the consequence of this setup is smaller welfare gains (or, in this case, a loss) due to limited factor mobility.

On the other hand, lower tariffs in the United States are unambiguously welfare-enhancing for Honduras. Higher export prices raise producer incomes, which allows the households to increase their consumption levels since the direct tax rates remain virtually unchanged relative to BaU. Therefore, this decomposition helps explain the modest overall welfare gains under the C_{BL} scenario. Due to a relatively low initial level of protection in the US, the removal of tariff barriers does not translate into a large increase in export volumes in Honduras. At the same time, the lowering of tariffs in Honduras requires an increase in taxes that dampens growth in disposable incomes, which prevents consumers from taking full advantage of lower import prices.

The welfare gains reported above are significantly below the estimates provided in the earlier CGE literature on DR-CAFTA. There are several reasons for this outcome: the gains are specific to Honduras (rather than Central America in general), the tariff data are much more recent (the base year is 2004 rather than 2001 or 1997), the impact of liberalization of service sectors is not taken into account, the reform is revenue-neutral, and tariffs are removed gradually rather than all at once. The last point is not trivial, but a sensitivity test in which all protection with respect to the United States is removed immediately yields welfare gains of 331 million in 2016, which is still considerably below the estimates in the earlier literature. This suggests that the other factors mentioned above contribute significantly to the difference with other studies, although their relative importance is difficult to ascertain.

The C_{BL}^{hi} column of Table 6 shows the results of implementing the same pattern of liberalization as the C_{BL} simulation, but under the assumption of a higher income elasticity for imports than for domestic goods. As a result, both imports and exports grow faster than in the previous simulations, and the trade-to-GDP ratio in the final year is almost 7 percentage points higher than in the C_{BL} scenario. The welfare gains in the C_{BL}^{hi} simulation are more than two-and-a-half times higher than in C_{BL}, reaching 0.2 percent of GDP in the final year. In this case, increased orientation toward imports drives down the Armington prices enough to slow the growth in the aggregate price level relative to the C_{BL} scenario (as measured by the household CPI). Consumer gains from access to cheaper goods outweigh producer losses from increased import competition and, despite further losses in tariff revenue, lead to (slightly) faster growth in disposable incomes and larger improvement in welfare. In terms of the remaining macro variables, the differences between this scenario and C_{BL} are not very large, confirming that the choice of elasticity values is not likely to have a large impact on the results when the relative price changes are mild.

The results of the C_{ML} simulation offer a significant contrast to the previously discussed scenarios. Welfare gains in this scenario are much larger at 0.7 percent of GDP in the final year, and account for 37 percent of the improvement in welfare that could be expected from full multilateral trade liberalization.[30] Imports from the CACM partners and the Dominican Republic rise by more than the imports from the US: in 2016, import volumes are 10,626 and 9,802 million lempiras above BaU, respectively. At the same time, the increase in export volumes to CACM and Dominican Re-

[30] Assuming high Armington income elasticities for the full (multilateral) DR-CAFTA implementation raises the welfare gains further to 2,202 million lempiras or almost 1 percent of GDP in the final year.

public markets is 33 percent larger than the increase in exports to the US: 7,869 million lempiras vs. 5,935 million. These results are not unexpected, since section 4.3 has shown that Honduran exporters face an average level of protection in the CACM/DR markets that is 5 times higher than the US tariffs, while the Honduran tariffs on imports from the CACM partners and the Dominican Republic are more than 30 percent higher those imposed on the rest of the world. Thus, Honduran consumers gain from significantly lower prices, while the producers are able to benefit from higher output prices as well as reap efficiency gains from having access to cheaper intermediate inputs. These results suggest that the real benefits of DR-CAFTA, at least on the trade side, may not come from slight improvements in market access to the US but rather from the implementation of the agreement across the CACM states and the Dominican Republic and the consequent reduction in intra-CACM protection.

6.3 Sectoral results

The previous section showed that the macroeconomic effects of trade reform with the US are likely to be very small. However, small changes in economy-wide aggregates often mask larger effects at the sectoral level. In order to explore these trends, Table 7 shows the changes in exports, imports, and production for each simulation at the level of detail of the micro-SAM. In this table, all changes are expressed as percentages relative to the final year (2016) in the baseline (BaU) scenario.

Consider the imports side first. Two main factors determine the growth in imports following the reduction in tariff barriers: the extent of the tariff cut and the US share in total imports. Table 3 showed that the structure of protection in Honduras is biased toward agricultural sectors, so with full elimination of tariffs one would expect the farm sectors to experience the strongest competition from imports. However, the C_{BL} simulation reduces agricultural tariffs only by two-thirds while completely eliminating manufacturing tariffs by 2016, which means that the greatest reduction in protection is experienced by the food, beverages, and tobacco and textiles sectors. Table 3 also showed that US imports account for approximately 40 and 35 percent of the total imports in these sectors, respectively. Therefore, these sectors experience the largest increases in import volumes following preferential liberalization with the US. In agriculture, the largest increases in imports take place in sugar and domestic crops. Although these sectors do not have the highest tariffs among all of the farm commodities, an overwhelming share of their imports comes from the United States (76 and 59 percent, respectively), which explains the larger-than-average increase in import volumes. Overall, tariffs in agriculture decline by slightly more than in manufacturing (the reduction in manufacturing tariffs is 4.67 percent while the reduction in agriculture is 4.86 percent) and this, combined with a slightly higher US share in total imports, explains why imports of farm products rise more than the imports of manufactured goods.

Turning now to the exports side, the effects on exports and total production are determined by changes in the domestic and export prices. The previous paragraph established that the effects of tariff liberalization on consumer prices are limited by the relatively low import dependence of the most affected sectors. While the imports price index (excluding services) decreases by 1 percent relative to BaU, the domestic price index falls by 0.1 percent.[31] This reflects the small magnitude of the market share losses experienced by domestic producers as a result of increased competition from imports. However, even a small reduction in domestic prices creates incentives for domestic producers to sell a larger share of their output abroad. The ability of firms to re-orient their

[31] The domestic price index is calculated as a weighted average of domestic prices for domestically produced goods, where the weights are domestic demand volumes in the base year.

production toward foreign markets depends on the initial share of exports in total production,[32] the slope of the exports demand curve, and the transformation elasticities between exports and domestic supply (CET elasticities).[33] As mentioned in section 5, the CET elasticities used in this paper are not particularly high, and the small country assumption ensures that Honduran producers face constant prices on the world market regardless of the volumes they desire to sell.[34] Therefore, the final changes in export volumes are determined largely by the export orientation of each sector and the increase in export prices due to tariff liberalization in the US. Not surprisingly, the largest gains by far are recorded in the textiles sector, which was the most highly protected sector in the US market (Table 4). However, the increase in the export volume of food, beverages, and tobacco—the only other sector facing significant protection in the US—is smaller than several others including bananas, coffee, wood, and mining. This is explained by the fact that all of these sectors are highly export-intensive (the shares of exports in total production are 57 percent and above); therefore, falling domestic prices combined with negligible levels of protection in the US and the EU encourage Honduran firms to re-allocate production toward foreign markets.

The effects on total production are consistent with the analysis of the previous two paragraphs. Rising export volume is enough to offset the market share losses due to increased imports in the majority of sectors. There are also important second-order effects, since producers are able to take advantage of lower prices of intermediate goods to become more competitive in domestic or export markets. For example, many sectors are aided by the gradual elimination of tariffs on petroleum and petroleum products. These second-order effects help explain why import volumes in sectors such as mining and livestock decline at the same time as import prices are falling.[35] This occurs because the cost savings through lower prices of intermediate goods allow domestic producers to become more competitive and increase market share even with lower levels of external protection. Finally, firms in expanding sectors also take advantage of resources (labor and capital) released by contracting import-competing sectors.[36] Overall, however, with the exception of several heavily export-oriented sectors, the changes in output are generally mild. In fact, total output rises by just 0.9 percent relative to BaU, consistent with the macroeconomic results of the earlier section.

As before, the C_{HN} and C_{US} columns decompose the total effect of bilateral tariff reform (C_{BL}) into its respective components. Under own liberalization, changes in import volumes are slightly smaller than under bilateral trade reform, which is largely due to slower income growth (disposable income grows by 4.17 percent per year as opposed to 4.19 percent average annual growth under C_{BL}). Perhaps the most interesting aspect of C_{HN} is the changes in domestic production, which isolate the effects of import competition from the impact of changing export prices. In agriculture, where the import content of final demand is relatively low, changes in production volumes are similar to those recorded in the C_{BL} simulation. On the other hand, the volume of production in the much more import-competing manufacturing sector declines significantly relative to the C_{BL} scenario. Combined with the C_{US} column, these results show that most of the DR-CAFTA production gains in the agricultural sectors come from lower prices of intermediate goods, while changes in production in manufacturing sectors occur largely due to the lowering of tariff barriers in the US. Since the latter decline only marginally, the overall effect on production in manufacturing

[32]This is also a measure of revealed comparative advantage of Honduran firms.

[33]More fundamentally, this response also depends on social and economic infrastructure and institutions, such as roads, ports, access to information and credit, marketing facilities, etc.

[34]Recall this does not apply to sugar destined for the United States because of the sugar quota.

[35]Note that these reductions are taking place from a very small base, since the import content of domestic demand in these sectors is extremely low (0.2 and 2.7 percent, respectively).

[36]This point will be discussed in more detail in section 6.4.

sectors is negative.

The pattern of adjustment in the C_{BL}^{hi} scenario largely parallels that of C_{BL}. Since demand growth in this scenario is more import-intensive, imports volumes increase more than twice as much as in the C_{BL} simulation. The effects on exports volumes are also much larger than under C_{BL}, which is largely due to the same mechanisms as those identified in the previous paragraph. Consider the effects of C_{BL}^{hi} on domestic production. In agriculture, where the effects of lower input prices dominate the increased competition from imports, domestic producers are able to benefit even more by demanding more import-intensive inputs. In manufacturing, Honduran firms have difficulties competing with cheaper imports and total production rises by less than C_{BL} while also becoming more export-oriented. The net effect is a significant acceleration in total production, which increases from a 0.9 percent gain in the C_{BL} scenario to 1.9 percent in C_{BL}^{hi}.

The outcome of the C_{ML} simulation is quite different from the scenarios described above due to the higher level of tariffs levied against the CACM partners and the Dominican Republic, combined with significant differences in the structure of protection and trade. The removal of protection vis-à-vis the rest of Central America leads to import volumes rising 2.8 times as much as in the C_{BL} simulation, while the volume of exports is 2.7 times higher. On the import side, the sectors experiencing the largest increases in imports include food, beverages, and tobacco, textiles, metals, minerals, and machinery, and domestic crops. Metals, minerals, and machinery register only minor changes in import volumes in the C_{BL} scenario, largely due to the fact that imports in this sector are protected from US competition by a relatively low tariff of 2.2 percent (as opposed to 8.8 percent tariff on exports from the rest of Central America). Thus, removal of protection throughout DR-CAFTA results in a larger increase in import competition in this sectors than tariff reductions with the US alone.

Unlike in C_{BL}, textiles is no longer the sector that experiences the biggest increase in export volume following the liberalization of trade throughout CACM and the Dominican Republic. Instead, metals, minerals, and machinery and paper register the largest gains due to the fact that the tariff rates in these sectors are more than twice the average faced by a Honduran exporter and the majority of exports of these products are already destined for the CACM and the Dominican Republic markets. Overall, the increase in the volume of non-farm exports outpaces the rise in farm exports by a factor of 5 to 1, compared with a 2 to 1 ratio in the C_{BL} simulation. The largest differences between the two scenarios, however, can be found on the production side. In contrast to the C_{BL} scenario, in which higher export prices and lower input costs in manufacturing led to a rather mild increase in the volume of output, in the C_{ML} scenario non-farm production rises by 10.9 percent relative to the baseline and 9.3 percent relative to the C_{BL} scenario. The magnitude of these changes should be interpreted with caution, since it is mostly driven by a very large production increase in a single sector. However, the overall pattern of changes in production in the C_{ML} scenario parallels the full liberalization outcome much more closely than the C_{BL} simulation. This suggests that bilateral trade liberalization vis-à-vis the US may not only result in a sectoral allocation of resources that is not fully consistent with a multilateral reduction in tariffs, but also inconsistent with a full implementation of DR-CAFTA. This issue will be addressed in more detail in section 6.5.

Table 7: Sectoral Adjustments, Percent Change with Respect to Final Year in BaU, Trade Scenarios

	Exports volume						Imports volume						Production volume					
	C_{BL}	C_{HN}	C_{US}	C_{BL}^{hi}	C_{ML}	FL	C_{BL}	C_{HN}	C_{US}	C_{BL}^{hi}	C_{ML}	FL	C_{BL}	C_{HN}	C_{US}	C_{BL}^{hi}	C_{ML}	FL
Bananas	19.8	44.2	-15.1	100.7	56.8	156.1	-0.3	-8.8	8.2	-23.0	15.5	15.4	18.3	40.9	-14.0	93.3	52.6	145.2
Coffee	21.1	24.5	-3.3	31.7	35.3	48.3	1.4	0.0	1.7	5.2	-1.4	29.3	20.4	23.8	-3.2	30.7	34.3	46.7
Sugar	2.9	3.3	-0.4	4.2	5.6	70.9	13.4	12.7	0.8	19.8	16.3	28.8	0.2	0.1	0.1	0.2	1.0	10.1
Mining	16.7	18.4	-1.4	16.8	60.7	172.1	-5.6	-4.5	-1.2	-1.6	0.0	-11.8	8.5	10.0	-1.4	8.3	40.0	107.5
Livestock	7.3	6.0	0.9	10.4	8.3	12.5	-2.9	-3.3	0.6	0.6	15.3	28.1	0.4	-0.3	0.7	0.1	0.5	1.8
Wood	15.6	16.3	-0.6	14.6	41.6	90.4	-4.2	-3.1	-1.0	-2.3	-6.6	-2.6	12.0	12.7	-0.7	10.3	32.3	68.4
Non-traditional crops	1.1	0.8	-0.6	2.2	-16.3	-28.2	5.9	3.5	2.3	9.1	16.4	34.9	-0.2	-1.0	0.2	-0.3	-13.5	-23.6
Domestic crops	4.3	5.3	-1.1	8.7	166.8	191.2	8.9	8.2	0.7	11.6	22.1	38.7	-1.6	-1.6	0.0	-2.1	0.3	-1.4
Oil							1.8	1.7	0.0	2.1	2.0	5.6						
Food, beverages, tobacco	11.6	0.2	10.7	13.4	29.5	75.1	22.3	19.9	2.1	30.2	39.9	51	0.6	-2.5	2.9	-0.2	1.4	5.8
Textiles	109.5	1.4	104.9	117.9	104.8	105.2	14.8	16.5	-1.3	20.9	23.5	47.6	5.5	-2.7	7.9	4.8	4.1	1.4
Paper	-2.0	1.6	-3.2	3.8	75.7	101.8	5.6	7.8	-1.0	20.1	15.9	34.7	-0.8	1.9	-1.9	3.4	12.1	22.5
Chemicals	4.0	6.4	-2.3	8.6	15.6	45.3	3.3	4.5	-0.8	9.8	7.9	16.2	1.0	2.7	-1.4	1.8	0.8	6.4
Metals, minerals, mach.	6.7	7.5	-1.0	11.6	321.7	455.4	3.8	4.2	-0.3	6.3	20.0	35.6	4.8	5.5	-0.8	8.8	200.1	282.9
Other manufacturing	4.6	8.1	-3.3	7.4	18.8	42.7	2.8	2.7	0.2	4.2	4.8	8.5	-2.5	-1.1	-1.4	-3.6	-0.7	1.4
Electricity, water, gas	3.8	2.4	1.2	3.0	4.3	7.1	1.8	0.6	1.3	10.1	5.2	12.6	2.5	1.2	1.3	2.3	4.9	10.7
Construction							1.1	1.1	0.2	10.8	2.7	7.6	0.3	0.8	-0.3	1.9	0.2	2.1
Other services	-2.0	-0.3	-1.9	-0.5	-8.9	-16.9	1.2	0.6	0.8	9.2	4.4	10.0	-0.5	0.1	-0.6	-1.2	-2.7	-4.7
Total	5.5	5.8	-0.1	12.8	15.1	27.6	3.7	3.6	0.2	8.2	10.4	19.5	0.9	0.8	0.2	1.9	2.8	5.7
Agriculture	9.9	15.2	-3.9	28.0	16.6	37.1	6.4	5.1	1.2	9.3	17.5	33.8	2.8	4.4	-1.1	8.7	3.5	9.4
Manufacturing	18.8	5.7	12.6	22.0	81.6	137.8	4.4	4.7	-0.1	7.6	12.1	21.9	1.5	-0.9	2.4	1.4	10.9	19.0
Services	-2.0	-0.3	-1.9	-0.5	-8.9	-16.9	1.2	0.6	0.8	9.3	4.4	10.0	-0.3	0.2	-0.4	-0.6	-1.8	-2.8

Source: Author's calculations.

6.4 Factor markets

Until now, the analysis in this paper has been largely focused on the effects of final goods prices on sectoral adjustment. However, changes in input prices also play an important role in determining the final equilibrium. The previous sub-section mentioned that the expanding sectors are able to increase output volumes by absorbing labor and capital that are released by the contracting sectors. Since the stocks of labor and capital grow exogenously in the simulations in this paper, the effects of trade reform on factor prices are mainly determined on the demand side and largely follow the sectoral factor intensities shown in Table 5.

First, consider the initial conditions, which are summarized in the second column (labeled "2004") of Table 8 for each factor type. Section 4.2 has already noted that the large wage differentials across farm and non-farm segments are indicative of barriers to labor mobility, and therefore justify the segmented labor markets approach of this paper.[37] The migration function allows a small number of workers to respond to these wage differentials by moving from farm to non-farm activities.[38] If non-farm wages grow faster than earnings in agriculture, migration rises; otherwise, it declines. Therefore, the evolution of factor prices in each of the simulations is determined by four major factors: labor supply growth rates, initial earnings differentials across segments (which can affect labor supply growth at the segment level through migration), initial factor intensities by sector (which determine which factors are most likely to gain or lose), and the pattern of growth (which determines the magnitude and direction of demand shocks).

Table 8: Initial Levels and Changes in Factor Prices and Migration, Trade Scenarios

	2004	BaU	C_{BL}	C_{HN}	C_{US}	C_{BL}^{hi}	C_{ML}	FL
Non-farm unskilled wage	37.13	0.63	0.72	0.71	0.64	0.71	0.86	1.11
Non-farm skilled wage	59.56	1.36	1.50	1.43	1.43	1.43	1.51	1.60
Farm unskilled wage	6.16	0.33	0.26	0.25	0.32	0.25	0.41	0.12
Farm skilled wage	10.16	0.28	0.15	0.14	0.29	0.12	0.33	0.01
Unskilled migration	7893	0.30	0.46	0.46	0.32	0.46	0.45	0.99
Skilled migration	504	1.07	1.34	1.29	1.14	1.31	1.18	1.59
Average unskilled wage	23.45	1.08	1.16	1.15	1.10	1.15	1.30	1.52
Average skilled wage	54.51	1.43	1.56	1.49	1.50	1.50	1.58	1.66
Average tertiary skilled wage	125.12	1.65	1.74	1.74	1.65	1.67	2.08	2.32
Average capital rent	1.00	-0.07	0.08	0.10	-0.09	0.15	0.20	0.42

Note: For each variable, the "2004" column contains the base year values. Wages are reported in thousands of lempiras, and rural-to-urban migration in number of workers. The real rental rate is normalized to one in the base year. Columns 3 through 8 show the average annual growth rates between 2004 and 2016 for each of the variables, in percentage terms. The growth rates are calculated assuming exponential growth between the first and the last period. All migration is internal to Honduras.
Source: Author's calculations.

The slight decline in the capital rental rate in the BaU scenario is explained by a gradual (albeit very small) rise in the capital-output ratio over time. Average, or economy-wide, wages of skilled and tertiary-skilled labor rise faster than the wages of unskilled workers because with rising incomes, demand for products with higher income elasticities increases faster than average and the production of these commodities (manufactured goods and especially services) is more

[37] Note that only the unskilled and skilled labor markets are segmented—workers with tertiary education are allowed to switch sectors freely.

[38] Recall that in the base year, migration is set to 1 percent of the farm labor force, excluding the tertiary-skilled.

skill-intensive (Table 5). Similarly, differences in wage growth at the segment level are explained by differential growth rates of labor demand by sector. Since farm production grows slower than total production (3.72 percent versus 3.94 percent per year, respectively), there is less demand for workers in these sectors and less upward pressure on wages. On the other hand, labor demand in non-farm activities exceeds the economy-wide average, resulting in growing wage differentials between workers in agriculture and other sectors. In response to these rising wage premiums, migration gradually increases throughout the model horizon.

Under the C_{BL} scenario, the largest increases in production take place in the farm sectors, which use capital and land most intensively. Therefore, aggregate capital stands to gain the most from trade liberalization. Tertiary-skilled and secondary-skilled labor receive slightly smaller gains, and unskilled labor gains the least. In order to understand the reasons behind these developments, it is useful to consider the two decomposition scenarios. Recall that, in the model of this paper, capital and tertiary-skilled labor are complements at one level of the production process.[39] Therefore, in the C_{HN} scenario, which section 6.3 showed benefits mostly agriculture, capital and then tertiary-skilled labor are the biggest winners. On the other hand, under C_{US} the biggest gains are in manufacturing, which uses skilled labor intensively. In this scenario, skilled and then unskilled workers stand to gain the most. The combination of these two scenarios produces the final effects observed in the C_{BL} column of Table 8.

The evolution of factor prices under C_{BL} at the sectoral level is determined by the changes in sector production volumes (Table 7). Although total production of agriculture rises in the C_{BL} scenario, output of domestic crops contracts by 1.6 percent due to increased competition from imports. Since this sector is the largest employer of labor in agriculture (86 percent of unskilled and 94 percent of skilled agricultural workers are employed in this sector), labor demand falls and the wages of farm workers decline. In turn, slower wage growth in agriculture encourages a faster pace of migration toward non-farm occupations.

The changes in factor prices in the C_{BL}^{hi} scenario are largely similar to those in the C_{BL} simulation. As noted in section 6.3, C_{BL}^{hi} results in an even more pronounced increase in agricultural production. This accelerates growth in returns to capital, which increase by twice as much as in the C_{BL} simulation. Because the C_{BL}^{hi} scenario leads to even larger production losses in domestic crops (compared to the C_{BL} simulation), farm wage growth is slower than before.

Section 6.3 showed that the C_{ML} simulation benefits manufacturing much more than agriculture, which explains why skilled and unskilled workers receive the largest wage gains in this scenario. This also explains why non-farm workers gain relatively more, although both farm and non-farm wages grow faster than in BaU and C_{BL} since production volumes in both agriculture and manufacturing are higher in C_{ML} than in C_{BL}. The capital rental rate grows faster in this scenario than in C_{BL}, despite the fact that agricultural sectors are generally more capital intensive than manufacturing. This happens because a large share of production gains in manufacturing in the C_{ML} scenario is driven by one sector, metals, minerals, and machinery, which is quite capital-intensive. As a result, the economy-wide demand for capital is higher than in any of the previous scenarios, and the rental rate increases.

An important drawback of the analysis presented above is that all simulations assume a constant rate of unemployment and therefore discount any additional employment opportunities that

[39] In other words, the capital/labor bundle is composed of a capital/tertiary-skilled labor bundle and a secondary-skilled/unskilled labor bundle. Therefore, at this node of the nested CES structure, tertiary-skilled labor and capital are complements. At the next level of CES disaggregation however, capital and tertiary-skilled labor become substitutes.

may be created or lost through DR-CAFTA. While the introduction of a flexible unemployment rate through semi-rigidity in wages is straightforward in the CGE model used in this paper, the specification of the minimum wage path that gives rise to unemployment is much more complicated. In order to provide a quick illustration of the potential employment effects of DR-CAFTA, we instead implement a simple approach of fixing real wages at BaU levels and allowing the growth of the labor supply to become endogenous. In other words, labor supply in every time period is determined by labor demand. The results show that by 2016, the employment of unskilled, skilled, and tertiary-skilled workers would rise by 3.6, 5.3, and 3.9 percent relative to BaU under the C_{BL} liberalization schedule. Overall, an additional 136,788 jobs are created in this scenario—a 3.9 percent increase from BaU—and 66 percent of these new workers are unskilled. Most of this increase comes from employment gains in the non-farm sector: while agricultural employment increases by 7,710 workers, employment in non-agriculture rises by 119,590 workers.[40] Although the magnitude of employment gains is not large relative to the total stock of workers (3.8 percent of total employment in 2015), the additional jobs created in this scenario are approximately equal to the base year employment in all agricultural sectors with the exception of domestic crops. Furthermore, the real GDP gains in this scenario significantly surpass the GDP effects of other simulations due to the increase in the stock of productive factors. Therefore, these results suggest that even a moderate degree of wage rigidity (a plausible assumption for Honduras) may give rise to significant employment creation following the bilateral liberalization of trade vis-à-vis the US. They should also assuage one of the main concerns of policy makers with regard to trade reform: potential employment losses in agriculture.

6.5 Compatibility of regional liberalization with multilateral reform

Up to this point, we have considered the effects of various trade liberalization scenarios independently of each other. However, since negotiations on regional and multilateral reform often take place simultaneously, policymakers are legitimately concerned about the compatibility of various liberalization scenarios with each other. Since entering into comprehensive trade liberalization agreements may be politically difficult, policymakers may prefer to sign smaller and/or regional agreements as stepping stones toward broader reform in the future. This section provides an empirical assessment of such strategies by contrasting the patterns of structural adjustment implied by the DR-CAFTA scenarios with full trade liberalization vis-à-vis all trading partners. In other words, we would like to know whether the "partial" liberalization scenarios result in a sectoral allocation of resources that is compatible with full liberalization, in the following sense. If partial liberalization attracts resources to the same sectors that would prosper under free trade, the scenario is considered congruent with the full liberalization. If, on the other hand, a scenario results in a sectoral allocation of resources different from that implied by full liberalization, then additional costs must be incurred to re-allocate resources when (if) free trade is concluded. Using the terminology of Bhagwati (1991), the regional agreement in the latter example could be characterized as a "stumbling block" rather than a "building block" toward a global free trade regime.

In order to assess the compatibility of each partial scenario with global reform, this paper relies on a congruence metric proposed in World Bank (2004, Chapter 2), which is a measure of labor market "churning" generated by each scenario. This labor market adjustment consists of two parts: (1) movement from the initial equilibrium to the partial reform scenario, and (2) movement from

[40] The total does not sum to 136,788 jobs reported earlier because tertiary-skilled labor (included in the latter) is not segmented by sector.

the partial reform scenario to global free trade. Thus, it is a two-step distance from the initial point to full liberalization, and, if the partial reform is perfectly compatible with free trade, this distance should be exactly equal to the one-step distance of moving from the initial point to full liberalization directly. This measure of congruence is normalized so that it is equal to one when a partial reform is perfectly compatible with global free trade, and is greater than one when additional labor market "churning" is required to reach the desired outcome in two steps. Congruence δ is formally expressed as follows:

$$\delta = \frac{\left(\sum_i \left(\frac{LD_i^p}{LD^p} - \frac{LD_i^0}{LD^0}\right)^2\right)^{\frac{1}{2}} + \left(\sum_i \left(\frac{LD_i^f}{LD^f} - \frac{LD_i^p}{LD^p}\right)^2\right)^{\frac{1}{2}}}{\left(\sum_i \left(\frac{LD_i^f}{LD^f} - \frac{LD_i^0}{LD^0}\right)^2\right)^{\frac{1}{2}}} \tag{2}$$

where LD_i is labor demand by sector, LD is total labor demand, and 0, p, and f denote the base year, final year of the partial reform, and final year of the full reform, respectively. It should be noted that this measure of congruence is sensitive to the level of aggregation of the model (i.e. the number of sectors), and, *ceteris paribus*, is likely to be higher in models with finer levels of sectoral detail.

Table 9 summarizes this congruence measure for some of the simulations described in the earlier sections. In all cases, preferential reform implies a pattern of sectoral adjustment that is inconsistent with full liberalization against all trading partners (FL). The largest differences between partial liberalization and full reform are observed for the C_{BL} and C_{BL}^{hi} scenarios. This is because tariffs in Honduras are already low and biased against the rest of the world (excluding the US and the EU). Therefore, further liberalization vis-à-vis the US results in an additional deepening of this bias, which must be corrected when tariffs against all trading partners—and their tariffs against Honduras—are eliminated. In particular, trade reform in the C_{BL} and C_{BL}^{hi} scenarios heavily favors agricultural production, while full liberalization (FL) benefits manufacturing relatively more. On the other hand, in a scenario where the DR-CAFTA preferences are phased in with regard to all trading partners, the congruence metric is significantly lower. This result is not surprising since section 6.3 has shown that C_{ML} benefits manufacturing production relatively more, and this brings the country closer to the full multilateral outcome (FL).

Table 9: Congruence between DR-CAFTA and Full Trade Liberalization

	C_{BL}	C_{BL}^{hi}	C_{ML}
Distance: baseline (BaU) to partial	1.23	1.23	1.04
Distance: partial to global (FL)	0.45	0.41	0.22
Congruence	1.67	1.63	1.25

Source: Author's calculations.

Since the movement of workers across sectors is rarely frictionless, these results suggest that the implementation of DR-CAFTA as a hub-and-spoke arrangement between the US and CACM partners (together with the Dominican Republic) could be very costly in terms of subsequent transition to global free trade, should it occur. Although we lack a truly global model with which to contrast the patterns of regional and global comparative advantage for Honduras, this result implies that the products Honduras sells to the US may not represent its global comparative advantage if all trade barriers were removed. While the analysis in this section is largely illustrative, it does show the importance of the sequencing of trade reforms. For example, policymakers may be inclined to advocate “minor” regional liberalization as a stepping stone to “major” global reform. However, as shown in Table 9, such policy may re-inforce the existing biases in trade structure in a country like Honduras. The sequencing of reforms becomes particularly important when labor markets are not very flexible because the costs of reallocating labor once for the regional and then again for the free trade scenario could be very high, both in terms of lost incomes and productivity and increased government spending on job training and social safety nets. Although these costs are not captured in the model employed in this paper, they are likely to lead to even lower welfare gains than are suggested by the simulations in the previous sections. On the other hand, some of these costs could be mitigated by various advantages of regional cooperation which are also not considered in this analysis, such as economies of scale generated by larger markets and improvements in investment climate. However, the key message is that reallocating labor across sectors is costly, particularly so when labor markets are rigid, and failure to carefully consider the sequencing of trade policy reforms can result in large additional adjustment costs.

7 Foreign Direct Investment

7.1 Description of simulations

In the simulations presented up to this point, the removal of merchandise trade barriers has been the only driver of allocative effects and welfare gains or losses from DR-CAFTA. However, changing trade prices may not be the only, or even the largest, source of benefits for Honduras. For example, exporting and importing more varieties of goods, as well as importing products with higher R&D content, may result in significant productivity spillovers in the domestic economy. Similarly, the implementation of DR-CAFTA may lead to an increased level of FDI inflows, which could provide an important source of financing for capital-intensive industries, spur the development of new sectors, and bring newer and more productive technology to Honduras. In fact, Medvedev (2006a,b) has argued that the expectation of increased FDI inflows is a likely driver behind the proliferation of new PTAs, and that the FDI benefits (which are significant for a large sample of countries and agreements) may be more important than the preferential tariff reductions.

There are a number of reasons to expect FDI inflows to increase following the implementation of DR-CAFTA provisions between the US and Honduras. Following the framework in Medvedev (2006a), one could identify five main transmission channels which could lead to higher FDI inflows both from the US and third parties (i.e., countries that are not members of DR-CAFTA):

1. Removal of barriers to cross-border investment flows
2. Improvements in investment climate (e.g., through trade capacity building efforts)
3. Complementarity of trade and investment flows (establishment of production networks)
4. Access to a larger common market
5. Dynamic growth effects

Without major modifications to the current model structure, it is not possible to model any of these channels explicitly. For example, we do not have any estimates of barriers to investment flows, or even a good idea of trade barriers in the service sectors. Similarly, it is not easy to incorporate measures of investment climate into a real model. In addition, the current model structure does not include features that allow FDI to have certain "special" effects on the domestic economy, such as increasing returns to scale and endogenous mark-ups in a Dixit-Stiglitz framework, product differentiation by firm ownership and location of production, or the use of business services (provided by both domestic firms and foreign multinationals) as essential inputs into the production process (see Lejour and Rojas-Romagosa, 2006, for a review of relevant literature). Instead, this section considers some basic links between preferential trade liberalization and FDI inflows through reduced-form parameter estimates obtained from econometric studies. Although clearly simplistic, the approach is very transparent while still allowing us to evaluate the different channels of transmission of FDI shocks.

In order to implement the FDI scenarios in this section, we make several modifications to the dataset and the dynamic updating equations. To accurately model the increase in foreign capital stock following the potential acceleration in FDI, we need to distinguish capital by ownership type (domestic or foreign) and, for the agricultural sectors, to distinguish capital from land. The latter is important because, as shown in section 4.4, capital intensities in agriculture are much higher than capital intensities in manufacturing and services, which is a result of attributing all land and natural resource income to aggregate capital, as well as potential misclassification of self-employed income. This issue was not particularly relevant for the trade simulations but is very important for the scenarios in this section, since the base year distribution of capital stocks by sector largely determines the allocation of new investment. Unfortunately, data on capital and land value added is not readily available for Honduras, and therefore we rely on the Central America SAM from GTAP to separate the two. For each farm sector in this SAM, capital accounts for 47 percent of the total capital-land value added bundle, and we use this information to split payments to aggregate capital into capital and land payments for bananas, coffee, sugar, livestock, non-traditional and domestic crops. For the remaining sectors, all payments to aggregate capital are assumed to go to "proper" capital.

The next step is to distinguish capital by foreign and domestic ownership. Because data on capital stocks by ownership is not available for Honduras, we must make an assumption about which sectors use foreign capital in the base year and, more importantly, which sectors are likely to receive the additional FDI generated by DR-CAFTA. A simple solution would be to assume that foreign capital exists in every sector and, allowing the rental rate to be the same for both types of capital, use a fraction such as the ratio of capital income remitted abroad to total capital income to split the capital value added into domestic and foreign components. However, this approach is not likely to be very interesting or realistic. Instead, it is not implausible to assume that foreign capital will only flow into those sectors that are likely to experience the largest increases in export volumes following trade reform under DR-CAFTA. In particular, we consider the export changes generated by the C_{BL} scenario in the previous section, since much of the new investment is likely to be attracted by Honduras having improved access to the US market.[41] Therefore, we assume that foreign capital only exists and will be attracted to bananas, coffee, mining, wood, food/beverages/tobacco, and textiles and wearing apparel sectors (we will call these the FDI-target sectors). Assuming that rental rates are the same across all of these (mainly because any other assumption would require additional data that is not available), we can use the ratio of capital income remitted abroad to total capital income (7 percent) to calculate the payments to each capital type. This share, however, is not consistent with the composition of private investment, which is 84 percent domestic and 16

[41] See, for example, Medvedev (2006a), which uses a measure of an extended common market from preferential trade liberalization to quantify net FDI gains from joining PTAs.

percent foreign. If the foreign capital stock is only 7 percent of the total capital stock in Honduras while foreign investment is 16 percent of total investment, foreign capital must depreciate much faster than domestic capital to avoid a falling rental rate in the absence of any shocks. This is not very plausible; instead, it is likely that not all income from foreign capital is remitted abroad, and therefore payments to foreign capital should be higher than 7 percent of total capital value added. One solution is to use the ratio of total private investment to FDI, but this is problematic if we want to restrict our attention to the sectors mentioned above, due to the fact that foreign capital value added calculated in this way exceeds total payments to capital in these sectors. Instead, we assume that foreign capital stock accounts for 13 percent of total capital stock in Honduras, which ensures that both foreign and domestic capital grow at roughly the same rate under BaU conditions (see the discussion in the following paragraph).

On the factor supply side, FDI and domestic investment are now treated separately, rather than both contributing to a single pool of investment which adds to the last period's depreciated capital stock. Foreign capital is replenished exclusively through FDI, which grows at the same rate as GDP in the baseline.[42] We assume that all FDI is used as real investment in new assets, rather than the acquisition of existing assets. There is no easy way of separating the two in the model used in this paper; however, this implies that the numerical simulations that follow potentially overestimate the effects of new FDI on additional capital formation. Growth in the domestic capital stock in each period is determined by the volume of domestic investment, which is a fixed ratio of real GDP at market prices. The choice of the base year ratio of foreign to domestic capital stock ensures that both grow at approximately 4.3 percent per year. On the production side, we assume that foreign and domestic capital are imperfect substitutes.

In order to quantify the potential FDI gains for Honduras, we consider the changes in net FDI inflows and the FDI-to-GDP ratio in Mexico before and after NAFTA (Figure 2). Using the data from WDI, we calculate that the three-year averages for these variables increased by 133.2 and 143.7 percent, respectively. Since the two estimates are fairly close, we apply the increase in net FDI inflows (the former estimate) to the BaU FDI path in order to calculate the FDI shock. Compared to the baseline, where FDI grows from 3,645 million lempiras in 2004 to 5,949 million in 2016, this approach to calculating the investment shock projects FDI to increase to 13,874 million by 2016. The average FDI-to-GDP ratio more than doubles, rising from 2.7 percent in the baseline to 6.1 percent.

It is important to emphasize that our estimate of the potential increase in net FDI inflows in Honduras is not a forecast but simply an input into a simulation exercise. We believe that the magnitude of the potential shock, derived from the Mexico analogy, represents a reasonable guess of the possible effect on FDI in Honduras. Yet, there are several reasons why this increase may be too optimistic. Unlike the pre-NAFTA Mexico, Honduras does not share a border with the US, already has virtually tariff-free access to the US market through the CBI, and has to compete with other developing members of DR-CAFTA (as well as other countries with which the US has a preferential trade agreement) for the potential new FDI inflows. Furthermore, China is a much bigger factor today than it was in the mid-1990s, when NAFTA was adopted, and the post-NAFTA global FDI environment was more favorable than it is today (i.e., there was a global boom in FDI in the mid-to-late 1990s). All these factors suggest that it is far from certain that Honduras may be able to reap similar FDI benefits from DR-CAFTA as Mexico was able to gain from NAFTA. Thus,

[42] The growth rate of FDI is set in foreign currency units, but its contribution to capital stock is valued at base year domestic prices. Therefore, changes in the real exchange rate will affect the growth rate of foreign capital stock. Furthermore, this setup assumes away joint ventures of local finance or MNE subsidiaries.

Figure 2: Pre- and post-NAFTA FDI in Mexico
Source: WDI.

the FDI scenarios that follow should be viewed as a "best-case" scenario, although, for example, Medvedev (2006a) suggests that many countries have been able to reap even larger FDI gains from preferential liberalization.

Bilateral CAFTA and increased FDI inflows (I_{BL}). The first simulation in this section adds the FDI shock described above to the C_{BL} scenario described in section 6.1. For the moment, we leave aside the issues of dynamic growth effects of FDI as well as potential productivity spillovers, and focus only on the level effects. We also assume that new FDI is an addition to, rather than a replacement of, domestic investment. This does not need to be the case; for example, evidence from Mexico shows that while the FDI-to-GDP ratio rose significantly after NAFTA (Figure 2), total investment to GDP ratio rose only slightly.[43] Since it is difficult to predict *a priori* whether potential new FDI in Honduras is likely to be a substitute or a complement to domestic investment, we allow the new FDI to become a net addition to total investment in the current scenario and explore the implications of relaxing this assumption in one of the following simulations.

Increased FDI inflows (I_{00}). This decomposition scenario separates the effects of increased FDI inflows from the effects of trade liberalization by imposing the FDI shock of the previous simulation (I_{BL}) without any reductions in the level of tariffs.

Bilateral CAFTA and increased FDI inflows with FDI a substitute for domestic investment (I_{BL}^{sub}). This simulation is identical to the I_{BL} scenario except for the investment closure. In the I_{BL}^{sub} scenario, the investment-to-GDP ratio remains unchanged after the FDI shock, which means that the new FDI replaces domestic private investment rather than complementing it.

Multilateral CAFTA and increased FDI inflows (I_{ML}). In this simulation, tariff reductions are

[43]WDI data indicate that in the three years after NAFTA (1995–1997), the average investment-to-GDP ratio declined by half a percentage point relative to the average ratio three years before NAFTA. However, this decline mostly reflects the 2 percentage point drop in the ratio in 1995 as a result of the crisis. Looking at five-year averages shows that the post-NAFTA investment-to-GDP ratio rose by 1.6 percentage points, although this ratio has been declining since reaching a peak in 1999 and is currently identical to the 1992–1993 investment-to-GDP share.

phased in with respect to all participants of DR-CAFTA (US, CACM countries, and the Dominican Republic) in addition to increased net FDI inflows. The FDI shock is exactly the same as in the I_{BL} scenario, both in its magnitude and in the sectors that benefit from increased net FDI inflows. There are several reasons why one may expect the FDI shock to be different in this scenario: first, the implementation of DR-CAFTA as a multilateral arrangement gives Honduras improved access to a larger common market, and second, the sectors that benefit the most from the C_{ML}-type trade liberalization are not the same as the ones experiencing the largest gains in the C_{BL} scenario. However, the marginal increase in the size of the PTA market from implementing DR-CAFTA as a multilateral agreement is almost negligible because the combined GDP of Costa Rica, Dominican Republic, El Salvador, Guatemala, and Nicaragua was only 0.73 percent of US GDP in 2004. Therefore, if extended market size is an important determinant of net FDI inflows—as suggested in Medvedev (2006a)—the FDI shock would be virtually the same regardless of whether Honduras gains additional market access to its CACM partners. Furthermore, changing the magnitude of the FDI shock would tend to simply scale the results without affecting the pattern of adjustment.

On the other hand, we can expect more pronounced differences in the outcomes if I_{ML} and I_{BL} attract FDI to different sectors. However, if most of the new FDI is likely to arrive because Honduras gains access to the US market, then one would expect that FDI to be targeted to sectors that sell a large share of their exports to the US and/or are likely to experience significant improvements in market access to the US following trade liberalization (in other words, the sectors that gain the most in the C_{BL} scenario). Thus, although the implementation of DR-CAFTA provisions throughout the CACM partners and the Dominican Republic could result in a different magnitude and pattern of net FDI inflows into Honduras, we believe that major differences from the I_{BL} scenario are unlikely and therefore keep the same FDI shock in both I_{BL} and I_{ML}.

Bilateral CAFTA and increased FDI inflows with productivity spillovers ($I_{BL}^{\lambda^L}$). This scenario introduces the dynamic growth effects of FDI that were brought up earlier in this section. There are several reasons to expect that DR-CAFTA may lead to increased productivity levels in Honduras, including higher knowledge content of foreign investment, development of backward linkages between foreign subsidiaries and domestic firms, improved investment climate through the lock-in of reforms, trade capacity building promised by the US, or the exit of less efficient firms due to increased import competition (firm self-selection).[44] The implementation of this productivity scenario is almost identical to I_{BL} with the only difference being a modification to the labor productivity growth equation (1). The $I_{BL}^{\lambda^L}$ simulation adds a new parameter to this equation which allows labor productivity in all sectors to respond to faster growth in FDI inflows (productivity spillovers). Therefore, labor-augmenting productivity evolves as follows:

$$\lambda_{l,i,t}^{L} = \left(1 + \gamma_t^L + \chi_{l,i}^L + \chi_{i,t}^P\right) \lambda_{l,i,t-1}^L \tag{3}$$

where

$$\chi_{i,t+1}^{P} = \varphi_{fdi} \left(\frac{FDI_t}{FDI_{t-1}}\right) / \left(\frac{FDI_t^0}{FDI_{t-1}^0}\right) \tag{4}$$

and the 0 superscript denotes the time path of FDI in the BaU scenario. If φ_{fdi} is set at 0, equation (3) collapses to the earlier specification (1); a positive value of φ_{fdi} yields a higher level of labor productivity in the time period immediately following a period of accelerated growth in FDI.

[44]The last channel has received substantial empirical support in the literature on both high-income and developing countries, as summarized in Feenstra (2006). Trefler (2004) cautions that long-term gains in productivity can come at the expense of short-term employment losses as less efficient firms exit the market, although he argues that in the long term these losses disappear through employment creation in other, more productive plants.

The value of φ_{fdi} (or similar elasticities) has been the subject of extensive empirical research in the FDI literature. While economic theory has proposed multiple channels of potential FDI spillovers, econometric evidence of their existence is far from conclusive.[45] Using cross-sectional data, earlier studies on the subject have found positive productivity spillovers at the sector level. These include Caves (1974) and Globerman (1979), who provide evidence of a positive relationship between higher subsidiary shares and increased productivity levels in Australia and Canada, respectively. For developing countries, Blomstrom (1986) and Blomstrom and Wolff (1994) show that the share of foreign subsidiaries has a positive effect on efficiency and the rate of productivity catch-up in Mexico. However, these and other cross-sectional studies cannot establish causality: it is not clear whether the relationship between foreign ownership and productivity is positive because foreign investment generates significant spillovers or because FDI is attracted to more productive sectors. In order to address this issue, more recent research has focused on firm-level panel data, but the evidence in favor of positive spillovers is much less clear. For example, Haddad and Harrison (1993) find no evidence that foreign entry has had an effect on productivity growth of Moroccan firms, although the higher degrees of foreign ownership are associated with lower productivity dispersion. Aitken and Harrison (1999) establish a positive relationship between foreign equity participation and productivity for the foreign subsidiary plants, but negative spillovers for domestic firms in Venezuela. Similarly, Djankov and Hoekman (1999) find a positive effect of foreign investment on productivity of firms in the Czech Republic, but the relationship turns insignificant when the sample is reduced to domestic firms only. Other studies have instead focused on vertical (mostly downstream) rather than horizontal spillovers and have found a positive relationship between foreign investment and productivity growth in domestic firms. These include Blalock (2001) for Indonesia and Smarzynska (2002) for Lithuania.

Although the previous paragraph mentions only a few (out of the many existing) studies on the subject, one can already see three broad patterns emerging. First, the existence of productivity spillovers to domestic firms is uncertain, while the evidence for higher productivity among foreign affiliates is much more robust. Second, if productivity spillovers exist, they are much more likely to be found among firms that have backward linkages to foreign affiliates rather than firms in the same sector as the foreign subsidiaries. Third, the existing studies relate productivity spillovers to the share of foreign-owned firms in a sector, or the percentage of output sold to foreign-controlled subsidiaries, rather than FDI itself. Therefore, it is difficult to translate the findings of this literature into a value (or a range of values) for the φ_{fdi} parameter. This paper sets the φ_{fdi} parameter equal to 0.0005; given the baseline time paths for labor productivity and FDI, the average elasticity of $\lambda_{i,l}^{L}$ with respect to foreign direct investment in the $I_{BL}^{\lambda^L}$ scenario turns out to be approximately 0.003.[46] The elasticity estimates with respect to foreign ownership shares reported in the studies referenced above usually range between 0.03 and 0.06. Therefore, if one assumes that a one percent rise in net FDI inflows results in a less than one percentage point increase in the share of foreign ownership (at the economy-wide level), then our parameter choice is roughly consistent with the existing literature. In any case, given the large data requirements and complicated econometric techniques needed to generate point estimates of the φ_{fdi} parameter for Honduras, properly quantifying this elasticity would be beyond the scope of this paper. The aim of this simulation is to simply illustrate the qualitative importance of productivity spillovers.

[45] The following discussion is based on Iacovone and Perini (2007).

[46] Note that this elasticity is positive only for the manufacturing and service sectors; labor productivity in agriculture remains exogenous in this simulation.

7.2 Macroeconomic results

The behavior of the macroeconomic variables for each of the simulations discussed in the previous sub-section is summarized in Table 10. As before, the base year equilibrium and results for the BaU scenario are reported for ease of reference and comparison. It should be noted that the BaU results reported in Table 10 are not identical to those shown in Table 6 due to differences in the production nesting (two types of capital require an additional CET nest, as does the land-capital bundle) and capital stock updating equations. By 2016, the welfare gains in the I_{BL} scenario significantly outpace those observed under C_{BL}, reaching 1.85 percent of GDP. The additional gains can be attributed almost entirely to the faster rate of expansion in the capital stock, which grows by 5.11 percent per year in I_{BL} versus 4.26 percent per year in BaU. This can be seen by observing that welfare gains in the I_{00} scenario, in which world prices remain the same as in the BaU simulation, account for 95 percent of total welfare improvement in I_{BL}.[47]. Faster growth of the capital stock leads to more rapid growth of real GDP, which by 2016 is 2 percent above the real GDP in BaU.

The trade-to-GDP ratio increases by nearly 8 percentage points relative to BaU, compared with a 5 percentage point increase observed in the C_{BL} simulation. Furthermore, unlike the C_{BL} scenario, most of the increase in trade is due to faster import growth, while the acceleration in export growth is much more mild. The main reason for this is real exchange rate appreciation due to increase in foreign capital inflows. This is more easily seen in the I_{00} scenario, where the real exchange rate appreciates by 0.1 percent per year, or about 1 percent over the entire model period. This is a manifestation of "Dutch disease," when foreign capital inflows raise incomes and drive up domestic prices relative to world prices. These relative price changes make production less profitable in export-oriented and import-competing sectors, yielding a new equilibrium with lower exports, higher imports, and lower real exchange rate. These mechanisms are still present in the I_{BL} scenario, but the impacts of Dutch disease are mostly offset by falling import prices, which *ceteris paribus* lead to a depreciation of the real exchange rate. Therefore, these results show that lowering tariffs can be an effective vehicle for neutralizing the negative effects of Dutch disease on export competitiveness, in addition to the traditional policies of sterilization by means of a stabilization fund or public investment in infrastructure (which are not considered in this model).

Another way to look at the same issue is to consider a simple current account setup with only exports and imports. When the balance on the capital account rises due to increased FDI, imports must rise relative to exports in order to equilibrate the inflows and outflows of foreign currency. In order for the larger quantity of imports to be absorbed without a corresponding rise in exports, the real exchange rate must appreciate. In the absence of DR-CAFTA tariff cuts, the increase in imports would be allocated across Honduras' trading partners according to the BaU import shares; with trade reform, increased imports are biased toward the US. Thus, there is significantly less import diversion in the I_{BL} scenario when compared with C_{BL}. Imports from the US rise by 16,017 million lempiras (38.8 percent increase over BaU), while imports from other destinations fall by 3,140 million lempiras (11.4 percent decrease from BaU).

The welfare gains in the I_{BL}^{sub} scenario are 87 percent higher than in the I_{BL} simulation, despite the fact that real GDP per capita grows 0.26 percentage points per year slower than I_{BL} and 0.1 percentage points per year slower than BaU. This occurs because foreigners essentially take over much of the saving responsibilities of the Honduran households, and the share of saving in

[47] Please note that this is an observation rather than a rigorous decomposition exercise. The welfare gains from C_{BL} and I_{00} scenarios do not exactly add up to the total welfare improvement recorded in the I_{BL} scenario

Table 10: Initial Levels and Changes in Macroeconomic Aggregates, FDI Scenarios

	2004	BaU	I_{BL}	I_{00}	I_{BL}^{sub}	I_{ML}	$I_{BL}^{\lambda^L}$
GDP at market prices	135.7	4.20	4.42	4.40	4.12	4.50	4.46
Real GDP at factor cost	120.5	4.22	4.43	4.43	4.18	4.43	4.47
Real GDP at market prices	135.7	4.17	4.33	4.33	4.07	4.34	4.37
Private consumption	116.0	4.14	4.30	4.29	4.43	4.34	4.33
Public consumption	16.7	4.17	4.33	4.33	4.07	4.34	4.37
Investment	35.6	4.16	5.39	5.38	4.07	5.41	5.42
Private investment	28.3	4.16	5.65	5.63	4.07	5.66	5.68
Public investment	7.3	4.17	4.33	4.33	4.07	4.34	4.37
Exports	57.3	4.01	4.73	4.30	4.15	5.29	4.77
Imports	89.9	4.04	4.97	4.69	4.58	5.37	5.00
Real GDP per capita	19254	2.16	2.32	2.32	2.06	2.33	2.36
Real exchange rate	1.00	-0.03	-0.05	-0.10	-0.04	-0.05	-0.05
Welfare (EV)			4213	4011	7888	5474	5117
Trade-to-GDP	108.5	106.0	113.7	108.9	111.8	119.2	113.7
Investment/absorption	21.2	21.2	23.3	23.3	20.6	23.3	23.3
Prv. inv./absorption	16.8	16.8	19.1	19.1	16.3	19.0	19.1
Gov. inv./absorption	4.3	4.4	4.2	4.2	4.2	4.2	4.2
Gov. cons./absorption	9.9	10.0	9.7	9.7	9.7	9.7	9.7
Gov. total spending/abs.	14.3	14.3	13.9	14.0	13.9	13.9	13.9

Note: For each variable, the "2004" column contains the base year values. GDP and its components are in billions of lempiras, real GDP per capita is in lempiras, and all ratios are in percentage terms. Columns 3 through 8 show the average annual growth rates between 2004 and 2016 for GDP and components, GDP per capita, and the exchange rate. The growth rates are calculated assuming exponential growth between the first and the last period. Change in welfare is shown as the absolute difference (in millions of 2004 lempiras) between the value of the expenditure function in 2016 in BaU and in each of the other simulations. Ratios such as trade-to-GDP are shown as values in 2016 for each simulation.
Source: Author's calculations.

household disposable income falls from 17.4 percent to 14.0 percent. Although the "pie" is in fact smaller in the I_{BL}^{sub} scenario compared with I_{BL} (real GDP in 2016 in the former is 3 percent lower than in the latter), the share of the pie allocated to consumption increases enough to offset any potential losses to consumers and make them better off. This result is unlikely to hold in the long run, as the reallocation of resources from saving to consumption cannot forever offset the penalty of slower income growth, but, at least in the time span of our model, replacing domestic investment with FDI appears to benefit consumers. It should be noted, of course, that the utility function does not include saving and the EV metric is therefore explicitly biased toward producing the above results. Thus, the effects on welfare in the I_{BL}^{sub} scenario should be interpreted with caution. At the same time, this scenario clearly shows that if new FDI simply replaces domestic investment, the consequences for growth can be negative.

As before, the implementation of DR-CAFTA among all signatories (I_{ML}) results in much larger welfare gains than in the bilateral CAFTA scenario (I_{BL}). Welfare improvements in the former reach 2.38 percent of GDP in the final year, although the difference between the I_{ML} and I_{BL} scenarios is much less pronounced than between simulations that did not consider an increase in foreign investment inflows (C_{BL} and C_{ML}). This is due to the fact that the increase in investment flows is the same across both simulations, and, as shown above, faster growth in net FDI inflows accounts for the majority of welfare gains in the investment scenarios. In the I_{ML} scenario, growth in exports and imports accelerates significantly relative to both BaU and I_{BL}, and the trade-to-GDP ratio reaches its highest value yet (one percentage point above the C_{ML} simulation). Trade diversion is very small in this simulation, with imports from the US and the rest of DR-CAFTA rising by 20,427 million lempiras, while imports from the EU and the rest of the world fall by only 5,166 million lempiras.

The outcomes of the $I_{BL}^{\lambda^L}$ scenario are summarized in the final column of Table 10. Since the changes in trade prices are identical to the I_{BL} simulation, it is not surprising that the trade-to-GDP ratio as well as growth in exports and imports are virtually the same across the two scenarios. Welfare gains reach 2.23 percent of GDP in the final year, but as mentioned earlier, their exact magnitude is uncertain because it depends on the value of the φ_{fdi} parameter. Nonetheless, it is worth pointing out that the welfare improvement in this scenario is significantly above the gains observed in I_{BL} and reaches 93.5 percent of the gains in the I_{ML} simulation, due entirely to a 0.05 percent boost in annual labor productivity growth. Although the additional growth in real GDP per capita is not very large (0.04 percent per year over and above the growth experienced in the I_{BL} simulation), these results suggest that the realization of even minor technological spillovers could result in large improvements in welfare in Honduras.

7.3 Sectoral results

Having discussed the macroeconomic outcomes of the foreign direct investment simulations, we now turn to examining their effects on exports, imports, and production volumes at the sectoral level. These developments, presented as percent changes from BaU volumes, are summarized in Table 11. Since the pattern of trade liberalization is the same across scenarios that envision increased net FDI inflows and those that do not, all of the points emphasized in section 6.3 remain applicable here. In addition, two more factors drive the results of this sub-section. First, the increase in FDI is sector-biased, and therefore some sectors benefit much more than others. Second, the behavior of the real exchange rate (Dutch disease) adds another layer of complexity to the analysis, although the pressure on the real exchange rate is small in aggregate terms. Since most of the new action (compared to the trade simulations) takes place on the factor supply side in heavily export-oriented sectors, it makes sense to begin the analysis by considering the changes in sectoral exports first.

The largest increases in exports in the I_{BL} scenario are observed in textiles, food, beverages, and tobacco, coffee, and bananas. As mentioned in section 4.3, textiles and food, beverages, and tobacco are the only sectors facing significant trade barriers in the US, and increased export prices, combined with large inflows of foreign capital, allow export volumes to rise by 162 and 57 percent relative to BaU, respectively. Although there are no tariffs on bananas and coffee in the US (and therefore no change in world prices), exports of these commodities rise by as much as food/beverages/tobacco (in percentage terms) for two reasons. First, both bananas and coffee are very export intensive (exports are 90 and 98 percent of total production, respectively) and second, they are both fairly intensive in their use of foreign capital, which accounts for 52 and 39 percent of total value added, respectively. Therefore, producers are able to significantly expand their output and send a lion's share of that output abroad. Unlike textiles and food, beverages, and tobacco, however, there is little change in the allocation of these new exports across trading partners. Since world prices remain unchanged, the distribution of exports is largely determined by the initial shares (Table 4), which means that most of the bananas are destined for the US markets while the majority of new coffee exports go to the EU.

Table 11: Sectoral Adjustments, Percent Change with Respect to Final Year in *BaU*, FDI Scenarios

	Exports volume					Imports volume					Production volume				
	I_{BL}	I_{00}	I_{BL}^{sub}	I_{ML}	$I_{BL}^{\lambda^L}$	I_{BL}	I_{00}	I_{BL}^{sub}	I_{ML}	$I_{BL}^{\lambda^L}$	I_{BL}	I_{00}	I_{BL}^{sub}	I_{ML}	$I_{BL}^{\lambda^L}$
Bananas	56.3	52.6	33.2	63.3	57.2	-2.2	-9.0	-4.5	26.1	-2.1	53.0	49.6	31.0	59.7	53.9
Coffee	56.8	43.9	43.7	63.7	56.7	13.5	5.9	-8.3	14.1	14.1	55.9	43.3	42.7	62.7	55.9
Sugar	-0.8	-3.6	-2.3	1.5	-0.7	20.8	6.5	24.7	24.0	20.9	0.5	0.3	0.9	1.1	0.7
Mining	21.1	4.2	0.1	50.5	21.6	-0.4	6.1	-7.9	-0.8	0.2	13.2	4.7	-3.5	33.2	13.7
Livestock	7.1	-0.4	3.4	8.4	7.5	1.5	4.2	4.8	20.8	1.7	3.3	2.6	4.3	3.6	3.6
Wood	16.9	1.4	4.7	39.3	17.0	2.8	7.7	-6.4	0.4	3.5	14.4	2.6	2.5	31.9	14.5
Non-traditional crops	-9.7	-11.1	-36.3	-12.5	-10.1	15.4	8.4	25.5	25.0	16.0	-4.9	-4.9	-21.1	-8.2	-5.0
Domestic crops	-0.9	-6.3	-4.8	141.7	-1.8	12.9	4.0	15.8	28.6	13.5	-1.1	0.3	-0.8	0.2	-1.0
Oil						3.8	2.0	-0.5	4.7	4.3					
Food, beverages, tobacco	56.7	40.3	67.2	85.7	57.6	11.9	-9.6	11.3	27.1	12.1	10.9	8.9	13.9	13.5	11.3
Textiles	161.6	24.2	194.4	159.1	164.2	9.7	-4.7	6.3	17.9	9.8	13.8	5.4	18.0	12.9	14.4
Paper	-14.7	-12.3	-21.1	40.0	-14.0	16.9	12.8	13.6	24.6	17.5	-0.5	1.7	-5.2	5.0	0.1
Chemicals	-10.1	-12.7	-11.4	2.1	-9.3	13.4	11.0	5.9	17.6	13.5	1.1	1.1	-3.7	1.1	1.5
Metals, minerals, machinery	-8.0	-12.9	-22.9	132.9	-7.8	11.4	8.1	3.7	20.9	11.8	-3.7	-7.1	-16.9	85.2	-3.4
Other manufacturing	-1.2	-4.6	-7.8	10.6	-0.2	18.2	14.9	2.8	20.1	18.6	2.7	5.9	-7.8	3.5	3.4
Electricity, water, gas	0.3	-4.1	-34.4	-1.7	-0.5	10.7	8.8	28.0	14.5	11.7	7.0	4.2	1.9	8.7	7.4
Construction						20.8	19.7	5.0	22.9	21.2	14.1	13.9	-1.1	14.1	14.5
Other services	-11.8	-9.9	-13.3	-17.0	-11.1	8.2	7.1	8.7	11.0	8.6	-2.6	-2.1	-3.3	-4.4	-2.1
Total	8.6	3.4	1.5	15.8	9.1	11.3	7.8	6.4	16.5	11.7	4.3	3.5	1.0	5.6	4.8
Agriculture	26.5	20.0	6.6	34.3	26.5	12.9	6.2	18.0	24.8	13.5	9.5	7.8	2.1	11.0	9.7
Manufacturing	34.0	11.5	33.7	74.3	34.9	12.3	8.1	3.8	17.7	12.7	8.1	5.8	6.7	13.7	8.6
Services	-11.8	-9.9	-13.4	-17.0	-11.1	8.5	7.4	8.9	11.3	8.9	0.3	0.6	-2.6	-0.9	0.8

Source: Author's calculations.

The other FDI-target sectors—wood and mining—experience smaller changes in export volumes. This is determined by the fact that the outward orientation of these sectors is lower (77 and 56 percent, respectively) while the world prices faced by producers of these commodities remain unchanged. Exports in most other sectors experience much smaller increases or even decline relative to BaU volumes. The latter is a result of a more pronounced real exchange rate appreciation in the I_{BL} scenario, combined with faster growth in domestic incomes. Increased domestic demand and a slight loss in external competitiveness motivate domestic producers to sell a larger share of their output domestically, which leads to a lower supply of exports. Overall, export volumes in the I_{BL} simulation rise by 55 percent more than in C_{BL}, with agricultural exports accounting for a larger share of the difference than exports in manufacturing.

Gains in total production in I_{BL} outpace those observed in the C_{BL} scenario by a factor of more than 4. With the exception of construction, the largest increases occur in the FDI-target sectors. The distribution of production gains across the FDI-target sectors is directly proportional to the share of capital in total value added: the higher this share, the more pronounced the gains in output. On the imports side, the changes are determined both by falling trade barriers and by the increased demand for intermediate inputs (some which are imported) by the sectors experiencing large production gains. For example, imports of metals, minerals, and machinery rise by 3 times as much as they do in the C_{BL} scenario, due, to a large extent, to the fact that this sector is both very import-intensive and the relevant commodity is highly demanded in the FDI-target sectors. This occurs despite the fact that imports of metals, minerals, and machinery from the US face the second lowest tariff in Honduras and therefore experience a relatively minor price shock. Overall, import volumes in the I_{BL} simulation rise by approximately 3 times as much as in the C_{BL} scenario, and most of the increases in imports can be attributed to the effects of faster growth in the foreign capital stock. This becomes evident when comparing the I_{BL} and I_{00} columns; the increase in FDI inflows in the latter simulation (i.e., without any changes in trade prices) accounts for 69 percent of the change in total imports observed in the former scenario.

As expected, production gains in the I_{BL}^{sub} simulation are much more mild than in the I_{BL} scenario, and are almost exclusively concentrated in the FDI-target sectors. Although consumer demand in the I_{BL}^{sub} simulation is higher than in BaU or I_{BL}, the reallocation of investment toward the FDI-target sectors limits the growth opportunities in the remaining sectors. As a result, the final year CPI is higher in the I_{BL}^{sub} scenario than in I_{BL}, while output growth is significantly slower. At the sectoral level, slower growth in the domestic capital stock is exacerbated by increased import competition, which is another factor leading to smaller gains in output. Slower growth of output (relative to the I_{BL} scenario) and increased consumption demand result in a much less marked expansion of export volumes. The differences between I_{BL}^{sub} and I_{BL} on the exports side, however, are limited almost entirely to the behavior of agricultural sectors while export volumes of manufactured goods rise by the same amount. This occurs because agricultural FDI-target sectors account for less than one-quarter of total output in agriculture and the lack of investment in the remaining sectors limits their ability to increase output, including output sold abroad. On the imports side, the increase in total imports in the I_{BL}^{sub} scenario is only 56 percent of the change observed in the I_{BL} simulation. However, agricultural imports increase by 40 percent more than in the I_{BL} scenario, while the increase in manufacturing imports is 4 times smaller than observed in I_{BL}. This happens because manufactured goods are a large component of intermediate demand, which is lower due to slower growth of output. On the other hand, agricultural commodities are mainly a final demand item and this, combined with lower output of several agriculture sectors due to falling domestic investment, leads to rising imports of farm products (particularly non-traditional and domestic crops).

As before, the implementation of DR-CAFTA across all parties to the agreement results in more pronounced changes in imports, exports, and domestic production. Unlike the I_{BL} simulation, the I_{ML} scenario favors the producers of manufactured goods, which is consistent with the pattern of protection faced by Honduran exporters in the DR-CAFTA markets. With the exception of wood and food, beverages, and tobacco, none of the FDI-target sectors face significant tariffs in the rest of DR-CAFTA (excluding the US), which explains why output and exports in the remaining FDI-target sectors do not experience large changes between the I_{BL} and I_{ML} scenarios. One exception to this observation is mining, which expands both its exports and production without any additional changes in export prices. This occurs because this sector intensively uses metals, minerals, and machinery as an intermediate input. While only 13 percent of total imports of this commodity (metals, minerals, and machinery) comes from the rest of DR-CAFTA, it is protected by a fairly high tariff, and the elimination of this tariff provides a large boost to the mining sector.

The pattern of changes in sectoral output in the $I_{BL}^{\lambda^L}$ scenario is similar to that observed in I_{BL}, which is not surprising since border price changes are the same across the two simulations. At the same time, the manufacturing and service sectors benefit relatively more than agriculture, where changes in production are almost the same as in the I_{BL} simulation. There are several reasons for this outcome. On the one hand, labor productivity in agriculture is exogenous and agriculture tends to be less labor-intensive than manufacturing and services (see Table 5). Both of these factors lead to faster growth of output in the non-farm sectors. On the other hand, the agricultural sectors also benefit from increasing capital productivity, while capital productivity in other activities remains fixed at base year levels (recall that both capital and labor productivity in agriculture grow exogenously). Since the FDI-target sectors include both farm and non-farm activities, farm activities are able to reap additional benefits from capital productivity growth. In the final outcome, growth of agricultural production remains above the growth in production of manufacturing, although the differential between the growth of output in the two aggregate sectors is reduced relative to the I_{BL} scenario.

7.4 Factor markets

The final piece of analysis of the FDI simulations is the evolution of factor prices, which is summarized in Table 12. These developments differ somewhat from factor price changes shown in Table 8 due to the different specification of the capital and land markets. First, consider the behavior of factor prices in the BaU scenario. The rate of return on foreign capital falls much more rapidly than the rental rate on domestic capital despite the fact that both foreign and domestic capital stocks grow at approximately the same rate (4.3 percent per year). The reason for this behavior lies in the different intensities of different types of capital by sector. In BaU, consumers spend a growing portion of their income on products with high income elasticities, in particular services, while the share of income spent on purchases of food and light manufacturing items declines. Since foreign capital is used exclusively in the production of the latter group of commodities, demand for foreign capital falls over time and the rental rate declines. Intuitively, one may think of the foreign capital owners willingness to continue investing in Honduras (despite the falling rate of return to their capital) as indicative of the large initial gap between the rental rate in capital-scarce Honduras and capital-rich source countries.[48]

The behavior of economy-wide wages in the BaU scenario can be explained using the same logic

[48] The initial differential is not observed in Table 12 because the rental rates are normalized.

Table 12: Initial Levels and Changes in Factor Prices and Migration, FDI Scenarios

	2004	BaU	I_{BL}	I_{00}	I_{BL}^{sub}	I_{ML}	$I_{BL}^{\lambda^L}$
Non-farm unskilled wage	37.13	0.64	0.96	0.85	0.62	1.10	0.99
Non-farm skilled wage	59.56	1.39	1.76	1.59	1.43	1.79	1.80
Farm unskilled wage	6.16	0.14	0.17	0.27	0.13	0.51	0.21
Farm skilled wage	10.16	0.12	0.09	0.25	0.11	0.43	0.13
Unskilled migration	7893	0.50	0.78	0.58	0.49	0.59	0.78
Skilled migration	504	1.27	1.66	1.34	1.31	1.36	1.66
Average unskilled wage	23.45	1.08	1.38	1.29	1.06	1.53	1.41
Average skilled wage	54.51	1.45	1.82	1.66	1.49	1.85	1.86
Average tertiary skilled wage	125.12	1.65	2.07	1.96	1.11	2.27	2.09
Average domestic capital real rent	1.00	-0.05	0.24	0.16	1.66	0.41	0.29
Average foreign capital real rent	1.00	-0.93	-7.27	-7.68	-7.63	-6.98	-7.23

Note: For each variable, the "2004" column contains the base year values. Wages are reported in thousands of lempiras, and rural-to-urban migration in number of workers. The real rental rate is normalized to one in the base year. Columns 3 through 8 show the average annual growth rates between 2004 and 2016 for each of the variables, in percentage terms. The growth rates are calculated assuming exponential growth between the first and the last period.
Source: Author's calculations.

as in section 6.4. Manufacturing and particularly services are relatively more skill-intensive, and as demand for these commodities rises faster than aggregate demand, skilled and tertiary-skilled workers become more scarce and earn higher wages. In fact, the evolution of wages by skill level is virtually identical between the BaU scenarios of Table 12 and Table 8. Similarly, growth in wages paid to non-farm workers in BaU is also very similar. On the other hand, growth in agricultural wages is about half what was recorded in the baseline with only one type of capital. This is due to the fact that producers in these sectors find it advantageous to substitute capital for labor due to the falling rental rate of foreign capital, which is used intensively in these sectors. As a result, there is less labor demand in agriculture, farm wages grow slower, and inter-sectoral migration rises.

In the I_{BL} scenario, the accelerated pace of foreign direct investment inflows leads to a significant decline in the rental rate of foreign capital, which is now more abundant. The fall in the rental rate is somewhat offset by increased demand for the output of FDI-target sectors due to trade liberalization (compare the rental rates of foreign capital between the I_{BL} and I_{00}) columns, but this additional demand is not sufficient to significantly counterbalance the relative abundance of foreign capital. On the other hand, the returns to more scarce domestic capital rise over time.

Since the production volumes of both agriculture and manufacturing rise significantly relative to BaU, wage growth in both segments of the labor increases. However, the acceleration is more pronounced for the wages of non-farm workers because production in the largest employer of farm labor—domestic crops—declines relative to BaU. As was the case in the C_{BL} scenario, tertiary-skilled workers gain the most in this simulation, followed by skilled and unskilled employees. Therefore, wage inequality, at least at the level of labor market detail considered in this paper, is likely to rise with DR-CAFTA. Furthermore, gains to non-farm workers significantly outpace the wage growth of farm employees.

Allowing FDI to be a substitute, rather than a complement, for domestic investment considerably limits the wage gains from trade liberalization and increased FDI. In fact, growth rates of sectoral and economy-wide wages as well as inter-sectoral migration are remarkably similar between

I_{BL}^{sub} and BaU. This result is not particularly surprising since production volume changes in this scenario are much more muted than in the simulations considered above, which leads to lower labor demand and less upward pressure on wages. The decline in the foreign capital rental rate is more pronounced than in the I_{BL} scenario (again due to lower production and demand), while returns to domestic capital rise significantly.

In the I_{ML} scenario, production volumes of both agriculture and manufacturing rise relative to I_{BL}, although additional gains in manufacturing output (68 percent) are much larger than in agriculture (16 percent). As a result, growth in non-farm wages accelerates. The most noticeable difference is a more than doubling of the growth rate of farm wages, which occurs due to the fact that production of domestic crops is no longer falling. At the economy-wide level, the biggest winners in this scenario (relative to BaU) are still tertiary-skilled workers, although the second place now goes to unskilled labor.

In the $I_{BL}^{\lambda^L}$ simulation, growth in economy-wide wages is only marginally faster than in the I_{BL} scenario. This result is an outcome of two factors. On the one hand, workers are paid their marginal product and therefore increased productivity raises labor earnings. On the other hand, less workers are needed for any given increase in output, which reduces growth in labor demand. This can be seen in the behavior of capital rental rates, which grow faster (or decline slower) in this simulation relative to I_{BL}. Since labor productivity in agriculture remains unchanged, labor demand in the farm sectors rises relative to others, which explains the faster growth in farm wages. However, since growth in non-farm wages also accelerates, migration remains the same as in the I_{BL} scenario.

8 Conclusions

The negotiations on DR-CAFTA were started with high expectations for the ability of the agreement to help the developing country members transition from a decade of poor growth performance to sustained improvements in income and welfare. In order to assess the likelihood of these positive developments, this paper has analyzed the likely patterns of adjustments to DR-CAFTA for Honduras with a dynamic CGE model. Several key messages emerge from the analysis. First, the welfare gains from bilateral tariff reform with the US are likely to be very modest, less than 0.1 percent of GDP. This is due to the fact that very little additional market opening takes place in the US, while Honduran producers face increased import competition and the government must make up the budgetary shortfall from lower tariff revenues by raising taxes or limiting spending. These welfare gains are much smaller than the estimates reported in the previous studies, which range from 0.5 to 4.5 percent of GDP. One of the reasons for smaller welfare gains in this paper is the use of much more recent (2004 vs. 2001 or 1997) tariff data, which means that the marginal reduction in protection considered in this paper is considerably lower than what the earlier literature used. Furthermore, the gains estimated in this paper are specific to Honduras, rather than the Central America average considered in the previous studies. In addition, rather than removing all protection at once, the modeling approach in this paper takes into account the gradual phase-in of tariff reductions as well as product exclusions and the different reduction schedules by sector (agriculture vs. manufacturing). Finally, we do not consider the implications of the liberalization of trade in services, which could potentially lead to larger gains, due to difficulties in quantifying service barriers.

The second message is that bilateral tariff reform favors agricultural producers of export crops, while manufacturing output rises less and production of domestic-oriented agriculture actually declines. These results differ from studies focusing on Central America as a whole (e.g., Francois et al., 2005), which argue that the largest increases in production are likely to take place in the textiles and apparel sector, but are consistent with the analysis of Bussolo and Niimi (2006) for Nicaragua, where agricultural production tends to increase more. This suggests that the outcomes for the poorest members of DR-CAFTA—Honduras and Nicaragua—are likely to differ substantially from the aggregate results for Central America. The sectoral results imply that trade reform is likely to be particularly beneficial for owners of capital and land, while unskilled workers gain the least and unskilled workers in the farm sector actually lose. Although the analysis is not accompanied by micro-simulations that could translate the changes in factor returns and consumption prices into poverty outcomes, the marginal effects of preferential liberalization under DR-CAFTA are unlikely to be beneficial for the poor, who tend to earn most of their income from unskilled labor and are usually concentrated in the agriculture sector. Furthermore, wage inequality is likely to rise, at least at the level of labor market detail considered in this paper. Ultimately, however, the effects on poverty and inequality will depend on the presence and design of complementary policies.

The third message is that the implementation of DR-CAFTA throughout all partner countries leads to significantly larger welfare gains of 0.7 percent of GDP. Furthermore, the "multilateral" DR-CAFTA scenario benefits manufacturing production relatively more than farm output, and results in an acceleration of growth in farm and non-farm wages alike.[49] The fourth, and related, message is that while neither of the DR-CAFTA liberalization scenarios is fully consistent with the pattern of sectoral adjustment that is likely to occur under a global free trade scenario, the "multilateral" DR-CAFTA is much more congruent with full liberalization than a bilateral DR-CAFTA with the US. In other words, the bilateral DR-CAFTA attracts labor to sectors that are likely to expand relatively less under global free trade and, should further global liberalization take place (such as the successful conclusion of the Doha Round talks), Honduras may be faced with significant adjustment costs as movement of labor across sectors is rarely frictionless.

The fifth, and perhaps most important, message is that the potential gains from non-trade channels potentially overwhelm the likely gains from tariff liberalization alone. The provisions of DR-CAFTA include a significant scope for the liberalization of investment flows between the members of the agreement. If DR-CAFTA leads to an increase in net FDI inflows roughly compared to that experienced by Mexico in the first three years following the implementation of NAFTA, welfare gains from just the bilateral reform could rise to 1.9 percent of GDP by 2016. If the new FDI under DR-CAFTA is able to generate positive productivity spillovers for the domestic economy—whether through knowledge transfers, backward linkages, or trade capacity building—welfare gains could rise further to 2.2 percent of GDP. Therefore, the numerical simulations in this paper suggest that investment, rather than trade, is the key to maximizing benefits from preferential liberalization in Honduras.

The results suggest that while some doubts about DR-CAFTA have not been baseless, the agreement can be an important part of the development strategy of Honduras. We identify several areas for policy attention by the government of Honduras (and potentially the international community) in order to maximize the potential of DR-CAFTA. First, policy makers should recognize that most trade barriers are likely to be found among the developing trading partners and thus focus their attention on obtaining improved market access to countries where the trade benefits are likely to be significant (such as the CACM partners). This is consistent with the analysis of Medvedev (2006b), which showed that North-North PTAs have no statistically significant effect on trade, while the largest trade creation effects were observed for South-South PTAs. Second,

[49] Capital and land are still the biggest winners in this scenario, however.

although Honduras is likely to receive little by way of additional market access to the US, the benefits of "deep integration" with high income partners could be large. The estimates in Medvedev (2006a) showed that the *ex post* relationship between preferential liberalization and increased net FDI inflows is driven by North-South and South-South PTAs, and the magnitude of the expected FDI benefits is increasing in the incomes of PTA partners. Thus, a properly implemented "deep integration" agreement with the US could result in large net FDI inflows and, as the results of this paper show, substantial welfare gains. Therefore, Honduran policy makers should do their best to exploit the provisions of DR-CAFTA to attract new FDI into the country. Under these conditions, the agreement could result in welfare gains that are orders of magnitude above the welfare increases from bilateral trade reform alone.

It should be emphasized that these benefits are not certain, however, and that DR-CAFTA also presents a number of challenges to the Honduran policy makers. First, the budgetary implications of tariff reform need to be carefully considered. If the government is to follow through on its ambitious plans to attain many of the Millennium Development Goals by 2015, it will need to replace the lost tariff revenue by alternative tax collection mechanisms. Additional borrowing is unlikely to be feasible given the current debt situation, but raising taxes presents other challenges. Indirect taxes tend to shift the burden onto poorer households, while direct taxes may be more difficult to collect. In the absence of these efforts, public spending may need to be cut, which could jeopardize the progress on the human development agenda as well as inhibit some of the policies Honduras needs to attract the potential FDI, such as investments in education and infrastructure. Second, the potential widening of wage inequality following trade reform may erode support for future reforms as well as increase the demand for public services that help workers adjust to these shocks, such as additional investment in education, job training, and social safety nets. Third, the sequencing of policy reforms also requires the attention of policymakers. This paper has shown that the pattern of structural changes implied by DR-CAFTA (especially when the agreement is implemented as a hub-and-spoke arrangement) may not be consistent with Honduras' comparative advantages under free trade and, should multilateral free trade talks advance, additional costly labor adjustments may need to take place. Even in the absence of global free trade, improved market access of, for example, Chinese textiles producers could be quite detrimental to Honduran exporters. Thus, Honduras should prioritize the pursuit of additional liberalization vis-à-vis other trading partners to more closely align the sectors that receive preferential access with the sectors where it has a global comparative advantage.[50] Fourth, maximizing the potential investment benefits from DR-CAFTA may require additional investments in infrastructure, education, health, sanitation, public safety, etc., to create an investment climate conducive not only to attracting FDI, but also to encouraging horizontal and backward linkages between foreign affiliates and domestic firms. However, this is likely to make the public revenue constraints even more binding.

It is important to acknowledge that, although the motivation behind this paper is to examine the likely effects of DR-CAFTA on the economy of Honduras, the simulations and their results should not be taken as forecasts of the future performance of Honduras under DR-CAFTA. The CGE model in this paper is not a forecasting tool; rather, it is a consistent framework for examining the transmission of trade liberalization shocks through the economy of Honduras. Any number of internal and external shocks could result in future outcomes significantly different from the results of this paper; however, the transmission mechanisms identified here are likely to remain valid and

[50] The same point applies to the transition from a hub-and-spoke DR-CAFTA arrangement to a comprehensive regional agreement, suggesting that the longer full implementation is delayed, the longer Honduras moves in the "wrong" direction.

the relative pattern of gains and losses is likely to hold. Furthermore, many of the closure rules adopted in our analysis (fixed current account, fixed government deficit, flexible real exchange rate that augments the direct effects of the DR-CAFTA tariff reductions on exports) may not be very realistic, but they have the benefit of generating consistent welfare outcomes that are comparable with other studies instead of "leakages" out of the system (e.g., with no transversality condition, the public sector can freely accumulate debt with no effects on the macroeconomy). Similarly, the baseline scenario constructed in this paper is very smooth, almost steady-state. While this unlikely to reflect reality, this assumption allows us to focus the analysis on the relevant provisions of DR-CAFTA by keeping the sources of variability tightly controlled.

While the results of this paper address many questions about the likely effects of DR-CAFTA on Honduras, many others remain for future research. One possible direction is locating data that would enable a researcher to conduct a more careful analysis of factor returns, such as more detailed data on land and capital by region of ownership. Also, the findings of this paper could be complemented with careful micro-simulation analysis to link the sectoral and macroeconomic results to poverty and distributional outcomes at the household level. Given the importance of external migration in the labor market dynamics of Honduras, the consequences of changing incentives to migrate internationally (most likely to the US) could also be investigated. Finally, more explicit modeling of the role of foreign capital in domestic production could help identify and quantify various channels of transmission of FDI shocks. These avenues would allow for a more nuanced understanding of the effects of preferential liberalization on the economy of Honduras.

A CES aggregation of Armington demand with non-unitary income elasticities

The Armington system of product differentiation by region of origin is implemented by aggregating demand for imported and domestically produced commodities into a composite good. In many CGE models, this is done by means of the CES functional form (often nested to allow for different substitution possibilities), while others use more flexible translog aggregation functions, such as the almost ideal demand system (AIDS) proposed by Deaton and Muellbauer (1980). The main advantages of the flexible functional forms include the ability to capture a wide variety of own- and cross-price elasticities, as well as allowing for income elasticities different from unity. However, the added flexibility comes at the cost of increased model size and difficulties in calibration, which cannot be done through simple matrix inversion and requires the user to set up an optimization problem. As an alternative, this section follows van der Mensbrugghe (2005b) to develop a simple extension to the standard CES aggregation which allows the income elasticities to deviate from unity. This is accomplished by adding shift parameters to the aggregation function—a modification similar to the set up of the LES system.

Consider the following representation of Armington demand:

$$XA = \left(b_d \left(XD - \theta_d\right)^{\rho} + b_m \left(XM - \theta_m\right)^{\rho}\right)^{\frac{1}{\rho}} \tag{5}$$

where XD and XM are the demanded quantities of domestically produced and imported goods, respectively. The θ parameters are often thought of as consumption floors or subsistence minimums, although there is no theoretical requirement that any of these parameters be positive. If both of the θ parameters are set to zero, the expression (5) collapses to the standard CES specification. The expenditure on domestic and foreign goods is limited by the total value of the Armington bundle, giving rise to the following budget constraint:

$$PAXA = PDXD + PMXM \tag{6}$$

The first order condition for XD is:

$$b_d XA^{1-\rho} \left(XD - \theta_d\right)^{\rho-1} - \lambda PD = 0 \tag{7}$$

After re-arranging, the demand functions for XD and XM are as follows:

$$XD = \theta_d + \beta_d PD^{-\sigma} \lambda^{-\sigma} XA \tag{8}$$

$$XM = \theta_m + \beta_m PM^{-\sigma} \lambda^{-\sigma} XA \tag{9}$$

where $\sigma = (1-\rho)^{-1}$ is the elasticity of substitution and $\beta_i = b_i^{\sigma}\ \forall i \in [d, m]$. Inserting these equations into the budget constraint (6) and re-arranging yields the following:

$$\lambda^{-\sigma} XA = \frac{PAXA - \theta_d PD - \theta_m PM}{\beta_d PD^{1-\sigma} + \beta_m PM^{1-\sigma}} \tag{10}$$

We can now derive the Marshallian demands by inserting this expression into equations (8) and (9) above:

$$XD = \theta_d + \beta_d PD^{-\sigma} \frac{PAXA - \theta_d PD - \theta_m PM}{\beta_d PD^{1-\sigma} + \beta_m PM^{1-\sigma}} \tag{11}$$

$$XM = \theta_m + \beta_m PM^{-\sigma} \frac{PAXA - \theta_d PD - \theta_m PM}{\beta_d PD^{1-\sigma} + \beta_m PM^{1-\sigma}} \tag{12}$$

These expressions can be simplified further by solving for the Armington price PA. First, insert them into the original Armington aggregation function (5) to obtain the following:

$$XA = (PAXA - \theta_d PD - \theta_m PM) \left(\beta_d PD^{1-\sigma} + \beta_m PM^{1-\sigma}\right)^{\frac{1}{\sigma-1}} \tag{13}$$

Next, solve the first order condition (7) for λ and use equation (11) and the above expression to simplify:

$$\lambda = \frac{b_d}{PD} \left(\frac{XD - \theta_d}{XA}\right)^{-\frac{1}{\sigma}} = \left(\beta_d PD^{1-\sigma} + \beta_m PM^{1-\sigma}\right)^{\frac{1}{\sigma-1}} \tag{14}$$

Since λ represents the price of relaxing the budget constraint by one unit, the Armington price is:

$$PA = \frac{1}{\lambda} = \left(\beta_d PD^{1-\sigma} + \beta_m PM^{1-\sigma}\right)^{\frac{1}{1-\sigma}} \tag{15}$$

Using this expression, we can simplify the Marshallian demand equations (11) and (12):

$$XD = \theta_d + \beta_d \left(\frac{PA}{PD}\right)^{\sigma} \left(XA - \frac{\theta_d PD + \theta_m PM}{PA}\right) \tag{16}$$

$$XM = \theta_m + \beta_m \left(\frac{PA}{PM}\right)^{\sigma} \left(XA - \frac{\theta_d PD + \theta_m PM}{PA}\right) \tag{17}$$

The income elasticities are:

$$\eta_d = \frac{\partial XD}{\partial PAXA} \frac{PAXA}{XD} = \beta_d \left(\frac{PA}{PD}\right)^{\sigma} \frac{XA}{XD} \tag{18}$$

$$\eta_m = \frac{\partial XM}{\partial PAXA} \frac{PAXA}{XM} = \beta_m \left(\frac{PA}{PM}\right)^{\sigma} \frac{XA}{XM} \tag{19}$$

These expressions are the same as income elasticities for the CES aggregation function, but they do not collapse to unity as long as the θ parameters remain different from zero.[51]

Calibration of this extended CES setup cannot be done through simple matrix inversion because the system is under-determined. Starting from initial estimates of the elasticity of substitution σ and the income elasticities η, the β parameters can be calibrated by inverting equations (18) and (19). The Marshallian demand equations (16) and (17) can then be used to solve for the θ parameters. However, equations (18) and (19) are not independent because the budget shares must sum to one from the constraint (6). A simple solution is to fix one of the θ parameters—in the current setup, θ_d is assumed to be zero, therefore implicitly setting the income elasticity for domestically produced goods to unity.

[51]This is easily seen by solving for the $\frac{XA}{XD}$ and $\frac{XA}{XM}$ ratios from equations (16) and (17).

B SAM accounts

Table 13: Microeconomic SAM Accounts

Type	Abbreviation	Full name
Activities/	ban	Bananas
Commodities	cof	Coffee
	sug	Sugar
	min	Mining
	liv	Livestock
	woo	Wood
	nta	Non-traditional crops
	sub	Domestic crops
	oil	Oil
	ali	Food, beverages, tobacco
	tex	Textiles
	pap	Paper
	che	Chemicals
	met	Metals, minerals, machinery
	oma	Other manufacturing
	ewg	Electicity, water, gas
	con	Construction
	srv	Other services
	gov	Public sector
Factors of	lab-n	Unskilled labor
production	lab-s	Skilled labor
	lab-t	Tertiary-skilled labor
	kaptl	Capital and land
Institutions	hhld	Households
	entr	Enterprises
	govnt	Government
Current and	xca	Rest of CACM and Dominican Republic
capital	eun	European Union (EU-15)
accounts	usa	United States
	xrw	Rest of the World
	bop	Balance of payments
Taxes	dirtx	Direct taxes
	imptx	Import taxes (tariffs)
	indtx	Indirect taxes
	prdtx	Production taxes
	vattx	Value-added taxes
Investment	invst	Private investment
	ginvst	Public investment
	delst	Change in stocks

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